SCIENCE

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*EXPEDITION TO SERILAND.**

BY the Spanish explorers and evangels, most of the territory lying west of the Sierra Madre and south of Gila river, in what is now western Sonora and southwestern Arizona, was called Papagueria, or land of the Papago Indians. The eastern and northern boundaries of the area were fairly defined, but the western boundary was vague. Toward the mouth of Colorado river the Papago country was separated from the Gulf of California by an arid tract of volcanic debris known as Malpais, a tract too utterly barren for habitation, traversed by the Indians only on annual pilgrimages to the coast for salt. Toward the south, Papagueria was separated from the Gulf, midway of its length, by the land of the Seri Indians, a tract peculiarly protected from invasion by natural conditions and defended against invaders by a warlike people.

As exploration and evangelization grew into settlement, the Spaniards affiliated with the natives, and a Mexican population and culture pushed into Papagueria; and to-day most of the valleys occupied of old by the Papago Indians are given over to Mexican villages, ranches, and stock ranges, only scattered groups of the aboriginal landholders remaining in Sonora, though their tenure is better maintained in Arizona. With the conquest of Papagueria, explorers

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pushed over the Malpais and a difficult trail was laid to California, then essentially a part of Mexico; and later, as American enterprise pushed toward the Pacific, another trail was pushed out, in part along the older one, and trod by pioneers until better routes were found along the Gila and further northward. The trails, Mexican and American, pass by the only known waters of the Malpais; and knowledge of the few widely separated tinajas* and springs was bought at the price of many lives. But while the Malpais was thus explored, albeit at great cost, Seriland was protected by a barrier desert and its savage owners so completely that the tide of exploration was practically checked; and Seriland remained unknown, save as to its coast, and except in a vague way as the home of a blood-thirsty tribe from time immemorial.

During the autumn of 1894 an expedition was conducted by the Bureau of American Ethnology through Papagueria and into the border of the Seri country for purposes of ethnic and collateral research; during the past autumn an expedition of related aim was conducted along other lines through Papagueria and into Seriland, which was thus for the first time explored and surveyed with some degree of thoroughness. The primary purpose of the later expedition was the making of collections representing the habits and customs, and especially the maritime life of the Seri Indians; but so far as practicable, advantage was taken of the opportunity for observation in other directions, not only in the Seri country, but throughout Papagueria. Some of the lines of observation may be indicated briefly.

*Tinaja, as used by Spanish Americans, is a natural bowl or bowl-shape cavity, specifically the cavity below a waterfall, especially when partly filled with water; in a more general way it is extended to temporary pools, springs too feeble to form streams, etc. In its specific application it has no equivalent in, and would be a desirable addition to, the English language.

GEOGRAPHY AND GEOLOGY.

The territory traversed by the two expeditions may be conceived as a great plain sloping southwestward from the foothills of the Sierra Madre to the Gulf of California, relieved by occasional rugged mountain ranges generally trending parallel with the high Sierra which divide the plain into a succession of lesser plains or broad valleys; and the great plain must be conceived as undulating somewhat, the chief irregularity being the subcontinental divide coinciding approximately with the international boundary.

The region is extremely arid, the annual rainfall averaging probably less than five inches, and perhaps less than two inches throughout the western half of the area. Streams gather in the mountain gorges, and those heading in the Sierra unite to form a few rivers; but as the waters push out over the plain they are partly evaporated, partly absorbed by the dry earth, so that even the highest freshets never reach the sea; and most of the streams flow only a few miles or at most a few scores of miles, and this only during the rainy seasons or after sporadic storms.

The mountains, especially the minor ranges of the Sierra, are notable for ruggedness and steepness of profile; they are remarkable also in that they usually rise from the plain abruptly or with relatively inconspicuous intermediate slopes—as a clever writer expresses it (picturesquely, but mistakenly, except in appearance) they are 'as men buried to the neck.' The mountain ranges are either naked rocks or steep talus slopes of coarse debris, supporting a scant sub-desert vegetation which increases in abundance toward the summits; the rocks being either metamorphic sedimentaries probably of Mesozoic age, or somewhat younger volcanics, a few nucleal ridges being granitoid. The broad intermontane plains are made up in part of alluvial or

torrential debris, fine at the lower levels, coarser toward the bounding foot-hills and ranges, though it is remarkable, and indeed paradoxical, that they consist in large part of the planed edges of hard rock strata such as form the adjacent mountains; the surface of the plain, whether built or carved, being sparsely dotted with trees and shrubs of sub-desert habit. Toward the coast the plains lie but little above and in some cases apparently below sea-level, and are composed of marine sediments, sometimes abundantly charged with recent shells; when the surface is usually a succession of playas and sand dunes.

Seriland is an exceptionally mountainous portion of the great westward-sloping plain, lying near the line along which it dips beneath the waters of the gulf; indeed a part of this staunch little dominion lies beyond the general coast line and is separated from the mainland by a narrow strait, itself the precise homologue of the upland intermontane valleys save that it is occupied by tide water and faintly sculptured by waves and tidal currents. The main insular portion of the territory is Tiburon Island, about 500 square miles in area; the continental portion is some 2500 square miles in area; and a few small islands adjacent to Tiburon and the Sonoran coast belong to the same natural district, and are held by the Seri Indians. Tiburon Island comprises half a dozen ranges, major and minor, the higher peaks rising from 3000 to 4000 feet above tide; in its principal interior valley there is a feeble stream, gathering among the higher peaks and wasting within a few miles, besides some half dozen tinajas and springlets. Sonoran Seriland is also mountainous, the culminating peak rising about 5000 feet above tide, and contains a feeble permanent spring and two or three water holes in which the water is brackish. Of the entire area south of Gila river and west of the Sierra, about four-fifths may be classed as plain, one-fifth as mountains; but in Seriland more than two-fifths and probably three-fifths must be classed as mountains, leaving only a moderate fraction to be classed as plain. This mountainous tract is separated from Papagueria by a broad waterless zone of playas and sand dunes, abounding in partially fossilized shells.

It is to this desert barrier, 20 to 40 miles across, that the isolation, and apparently many of the characteristics, of the Seri Indians are due; for it is a natural boundary, one of the most trenchant and effective on the Continent, practically impassable without special training, and so conditioned as to be easily defended along the inner margin in case of invasion.

When the mountains and intermontane plains of Papagueria and Seriland are examined in detail, certain peculiarities appear: As already observed, the mountains are notable for ruggedness and the plains for flatness nearly or quite to the mountain bases; again, the parallel ranges are found to be occasionally united by cross bars, so that a common form of mountain plan may be likened to the letter H; still further, it is found that the larger arroyas and rivers seldom follow the axes of the valleys, but usually flow athwart them and frequently traverse the bounding ranges in narrow gorges opening toward the gulf, while many southward-flowing streams head on the northern sides of the cross-bar ranges through which they pass in youthful canyons. On assembling these peculiarities, they are found to point toward two successive sets of geologic conditions: The distribution of the minor ranges with their transverse connections, coupled with the fact that a large part of the area of the intermontane plains is planed, indicates that the region was formely a plateau which maintained its altitude and attitude until the feeble sub-desert streams degraded the greater part of the mass, leaving only the

harder ledges and broader divides as remnantal ranges; while the incongruity of the modern waterways indicates that, after assuming this general configuration, the tract was tilted southwestward in such manner as to stimulate the streams flowing in this direction and paralyze those flowing northeastward, and thus to produce a general migration of divides. These indications may perhaps be misleading, or may have been misinterpreted; and the abrupt transition from rugged mountain slope to planed base-level is an attendant feature which requires explanation before the interpretation can be regarded as final. The researches relating to this subject are not complete, but both Mr. Willard D. Johnson, of the later expedition, and the writer have collected data bearing on the subject. Among other data may be mentioned an admirable section exposed along the gulf shore from Kino bay to San Miguel point (some 20 miles), in which the relations between rugged range, planed base-level, and torrential plain are clearly shown.

Mr. Johnson carried forward a planetable survey throughout Papagueria and Seriland, which will not only yield the first trustworthy map of the region, but will serve as a basis for the representation and interpretation of the geology. *

METEOROLOGY.

Throughout the expeditions of 1894 and 1895, noninstrumental observations were made on winds, clouds, precipitation, frosts, etc., and noted with considerable care, with the view of determining the influence of these elements of the weather on geologic process, on the flora and fauna, and on the human population, native and introduced. These notes, made incidentally at a constantly shifting base and for short periods only, would be of little value in a region adequately supplied with meteorologic stations, but acquire some value from the dearth of observations in the district to which they pertain, particularly since this district aids in shaping the weather conditions prevailing over a considerable area in southwestern United States. Prof. Cleveland Abbe has signified a desire to publish the notes in an early number of the *Monthly Weather Review* of the United States Weather Bureau, and the material will thus be made accessible to meteorologists. The notes acquire value also from the close relation between weather and life in this region.

It may be observed in brief that the chief weather characteristic of the region is aridity, the rainfall being limited in quantity and irregular in distribution; there are two nominally rainy seasons, in July-August and January-February, respectively, but rains sometimes occur at other times, while precipitation often fails during these seasons; but whether rain falls or not, these are seasons of greater or less humidity of the air, so that the flora is vivified semi-annually, whereby many species are undoubtedly enabled to survive the seasons of drought. The second weather characteristic is heat, especially at lower altitudes; the summers are oppressive for men and animals, the winters no more than pleasantly cool—the weather in Seriland may be inferred from the fact that, while these Indians have words for rain and hail, they have none for ice, snow, or frost. Another characteristic is the dearth of clouds, and the consequent intensity of light and fervidness of insolation by which the skins of men and animals are undoubtedly, and the habits of certain plants apparently, affected. Toward the coast, fogs are not uncommon in the autumn, and are said to occur at other seasons; this weather condition appears to affect the flora for 10 to 50 miles inland, according to the local configuration. The

* A preliminary impression of the Seriland portion of the map will appear in *The National Geographic Magazine* for April, 1896.

relations between weather and the life of the region, human and sub-human, are thus manifold—indeed not only the superficial but the fundamental characteristics of the living things, the very laws of individual and collective development, are largely traceable to weather conditions; but in a summary statement it is impossible to do more than suggest the bearing of the researches relating to this subject.

ARCHÆOLOGY.

During the earlier expedition it was ascertained that prehistoric works abound throughout much of Papagueria; during the later journeys the observations on this subject were extended. In almost every valley containing sufficient water to support a population howsoever limited, ruins of ancient villages, remains of irrigation works, etc., are found; the only exceptional valleys being those in which modern civilization is so extensive as to destroy the more conspicuous traces of earlier culture. Moreover, the prehistoric ruins are in general more extensive than the modern villages, while the ancient irrigation works and fields are carried further up the valley-sides than the modern acequias and farms, indicating that the ancient agriculture was the more extended. The artifacts found in the ancient villages prove that the prehistoric people were potters and that their fictile ware was somewhat finer in quality than that manufactured by the modern Papago; that they were a peaceful folk, using stone axes, mortars and pestles, hammers, footballs, etc.; that they had temples or other dominant structures more elaborately furnished than their ordinary dwellings; and there is fairly clear indication that they corralled a small domestic animal, but that they were without larger stock such as was later introduced by the Spaniards. Associated with these ancient relics of well-known kinds there is a distinctive class of ancient works known generally among the Mexicans as 'las trincheras' (entranched mountains), usually found in the immediate vicinity of fertile valleys and especially characteristic of portions of these valleys now, as in prehistoric times, especially adapted to settlement. Commonly the site is a steep-sided butte or isolated mountain several hundred feet high, and the work itself is a rough and rather irregular wall of loose stones circumscribing the butte near its summit; sometimes the walls are multiplied or built out into bastions, particularly on the gentler slopes, and they may be interrupted where the slopes are precipitous. The walls support either narrow pathways or broad terraces on which house-circles are sometimes found; and along and within the walls the ground is frequently sprinkled with potsherds and wasters of foreign rock. No granaries or reservoirs have been found within the enclosures, nor is there anything to indicate permanent or long-continued occupancy.

Specially noteworthy examples of this class of works were carefully surveyed during the recent expedition, near San Rafael de Alamito, in Magdalena Valley, 35 miles southeast of Altar; the two principal buttes being known specifically as 'Las Trincheras,' or as 'Trinchera' and 'Trincherita.' The larger butte, nearly a mile long and 650 feet high, is terraced from bottom to top half way round, and on the other side is walled and terraced in part; the smaller is similarly terraced most of the way round. The retaining-walls or revetments are massive and in some cases fully 20 feet in height, and are usually carried from two to five feet above the terrace in the form of breastworks, while free walls of equal height are distributed over the gentler slopes; and fragments of pottery and stone artifacts, as well as spalls and cores of transported rock, besprinkle the ground and might be collected in tons. These

works are conspicuous because of magnitude; the prehistoric works of Papagueria in general are noteworthy in extent, and in that they appear to indicate the existence of a more numerous population than that of historic times who stored and controlled storm waters and thus occupied a higher culture-plane than the modern Indian, Mexican and American inhabitants of the same region.

During the recent expedition it was ascertained that, while the prehistoric works of Papagueria stretch to the southwestern boundary of that territory they do not extend into Seriland, where no ancient works were found except shell heaps, cairns, etc., such as the Seri now accumulate. Some of the shell heaps are, however, of great volume and extent, and so situated as to prove that they have survived considerable geographic changes; thus a mound built almost wholly of clam shells (belonging to a series covering several acres) is some 60 feet high and over 300 feet in diameter, and is located on a part of the shore where there are now no clam flats, which the waves have invaded until a considerable part of the mound has been swept away—the section thus exposed revealing typical Seri potsherds and stone hammers from top to bottom. So Seriland appears to be an archæologic as well as an ethnic unit, and there is nothing to indicate that the territory was ever held by other people than the ancestors of the modern tribe.

BIOLOGY.

During the earlier expedition it was observed that the flora and fauna of Papaguara display certain characteristics which were ascribed to the influence of a peculiar environment; and during the later expedition further notes relating to this subject were made, and a small collection of plants was gathered and placed in the hands of Professor J. W. Toumey, of the University of Arizona, for identification and study. While the observations on plants and animals were in a measure casual and were not guided by expert knowledge, they proved particularly suggestive in their bearing on the relations between the human inhabitants of the same region and their environment. These biotic studies indicate that, in sub-desert regions, the development of the individual and the species is determined primarily by a rigorous enviroment; so that the course of development tends at the same time toward pronounced individuality and toward a complex system of coöperation among diverse organisms, whereby each immediately antagonizes, but ultimately serves, its contemporaries. Some of the inferences from the observations of the earlier expedition have already been stated* and need not be repeated; but many new examples, congruous with those previously collected, were noted.

Among the most interesting observations are those pertaining to the coöperative interrelation between animal and vegetal organisms, whereby each depends on the other for existence; this being the stage of vital coöperation called commensality. The best known examples of commensality are those of the fig and fig insect and the yucca and yucca moth, in which the relation was established by Riley; though a still more striking example, in which, however, the relation has not yet been demonstrated, is that of the saguaro, or giant cactus (*Cereus Giganteus*) and its insect mate. During the recent trip two distinct plants were found apparently to represent a still more complex miscigenesis: The cina (*Cereus schotti*), one of the most abundant cacti of southern Papagueria and Seriland, seems not to flower or fruit under what would commonly be considered normal conditions, but only

(* 'The Beginning of Agriculture,' American Anthropologist, Volume VIII., 1895, pp. 350–375.)

after attack and injury by a certain insect (not yet identified). Normally the young cactus sends up half a dozen or more massive stems, usually 5 to 10 feet high and 3 or 4 inches in diameter, beset with thorns along each of the 5, 6, or 7 ribs; subsequently branches spring from these stems, and the plant gradually expands into a clump or colony a dozen feet or yards across. Thus far the plant remains an individual, the product of a single seed; and the period of individual development undoubtedly covers a long term of years, since the younger branches remain vigorous long after the original stems have died and decayed. Now, so far as the observations go, they indicate that the plant does not necessarily or normally fructify during this term of individual development, but that if its insect enemy and mate chances to deposit eggs in the pulp toward the extremity of branch or trunk several changes supervene. In the first place the eggs develop and in due time the larvæ emerge and feed on the pulp; then the branch shrivels, losing a quarter or third of its diameter, and a pilage of slender spines or stiff bristles springs and soon covers the shrunken portion, which may be a foot or more in length; next, under the protection of these spines, a bright-colored flower is put forth, and this in time is followed by the fruit. It is of course to be borne in mind that this sequence has not been studied as a succession of stages in the same plant, but only as an unbroken series of stages exhibited by many plants, so that the sequence may not be regarded as established; but, so far as the observations go, they tend in that direction.

Essentially parallel to the behavior of the cina is that of the dicotyledonous bush called by the Mexicans torotito (not yet identified), the geographic distribution of which is about the same as that of the cina. For a long time this plant was a puzzle because no indication of the mode of reproduction was perceived. It grows in a clump of two or three or a dozen stems springing from a single root, and the colony or clump retains vitality much longer than individual branches, which apparently spring up, attain full growth, die, and decay, while yet the colony survives, so that, as in the case of the cina, the term of individual existence is manifestly long. At length it was noted that the extremities of the separate stems or branches occasionally present an abnormal appearance—tumescent, gnarled and twisted, with leaves or petioles attached; and on dissection it was found that such diseased twigs contain eggs or larvæ. Then, as the season progressed, it was found that the tumescent twigs—and these only—sometimes bear small flowers and, quite rarely, a nutty fruit. So in this case as in that of the cina, the flowering appears to depend on the development of an abnormal condition resulting from ovaposition by an insect (which was not seen in the imago form; but it seems not to be a necessary stage in in the history of any individual, since in many cases the tumescent twig withers and falls off without flowering and of course without fruiting, while only a small proportion of the flowers appear to produce nuts. In this case, too, the observations are suggestive, though not demonstrative, of an ontogenic sequence; yet it is to be observed that the sequence is in precise accord with the biotic relations prevailing in this district, under which the tendency is to perpetuate species by prolonging the life of the individual rather than by multiplying progeny, under which all living things tend to enter a solidarity of remarkable perfection, and under which phylogenic development is either forced and intensified or cut off by the pressure of an adverse inorganic environment. Granting the sequence, or even admitting only the indubitable interrelations found in the region, it follows that the living things of the desert conserve

much of the energy commonly expended in reproduction, and thereby approach the plane occupied by the higher animals, with man at their head, among which progeny are reduced in number and improved in the perfection of their adjustment to environment—the plane of solidarity founded on conscious or unconscious altruism, whose occupants, sometimes erroneously classed as sexually degenerate, are the socially regenerate of the earth in that they are fitted to the fulness of life in all its forms.

During the earlier expedition it was found that the plants of Papagueria, "howsoever divergent phylogenically, are notably convergent in a certain group of characters, including leaflessness, waxiness hairiness, thorniness, and greenness";* during the later trip these inferences were verified and corroborated, and it was also observed that still other features are common among genetically diverse plants. Thus, there is a series of trees and woody shrubs, including a half dozen desert forms known as torote, torotito, etc. (not yet identified), which are characterized by swollen trunks and squat forms, in which the woody tissue is pulpy in texture and saturated with watery or slightly viscid sap. When trunk or branch is wounded the sap exudes and quickly heals the wound, either by coating it with lacquer or encrusting it with gum; and when the plant dies the sap escapes and the wood shrinks and gapes widely, even before the bark decays, so that decomposition is rapid and the dead crop quickly makes way for the rising generation. This pulpiness of stem among ligneous plants is like unto the pulpiness of the cactus and agave, which appears to be a device for the storage of water; and while a few of the desert trees (ironwood, catclaw and paloblanca) are characterized by firm woody tissue, most of the arboreal forms consist largely of water-storing tissue, which may be inferred to represent phylogenic adjustment to an arid environment. Commonly these water-filled trees, with certain lesser shrubs abounding in viscid juices and gum, are acrid, astringent or ill-flavored, and some are alleged to be poisonous; others are pungent or noisome in odor (*e. g.* the yellow torote has a penetrating cedar-like odor which is highly offensive to many animals). Associated with these sappy and juicy plants there is a variety of spicy shrubs which in the settled districts are used as condiments and even as substitutes for salt in curing meat. Many of these plants are used medicinally; after describing in detail the virtues of thirty-six medicinal plants, the anonymous author of the 'Rudo Ensayo' (Sonora's classic, written in 1763), adds, "Among the great variety of plants found at every step there is hardly one that has not healing qualities;"* and there is reason to anticipate substantial additions to the pharmacopœa as the flora is studied systematically. Now it is noteworthy that the high-flavored and strong-odored plants are without thorns or other mechanical protective appurtenances; and, in view of all the relations, it seems almost necessary to infer that the flavors and odors are protective and the product of phylogenic development under the local conditions. If this be so, it would appear that the mechanical and chemical devices for individual protection are related reciprocally; and this corollary finds direct support in the characteristics of the cacti, for the juice of the scant-thorned cina is offensive to herbivores, while the well-thorned cholla and nopal are eaten by stock when the thorns are burned off by the vaqueros, and the bisnaga, thorniest of known plants, yields a nearly pure water which has saved the lives of scores of explorers (indeed the work of the last expedition was greatly facilitated by the supplies

* Op. cit., page 362.

* Am. Cath. Hist. Soc., of Philadelphia, Vol. V., 1894, p. 164.

drawn from this natural well of the desert).

Other relations among the plants and between the flora and fauna were noted, but in a summary statement it must suffice to indicate only a few leading lines of observation.

DEMOLOGY.*

In the course of the earlier expedition it was found that if the plants, animals and men of the desert be compared with respect to individual or physiologic (*i. e.*, purely biotic) characters "the stationary plants have suffered greatest modification, the environment-driven animals less, and the environment-molding humans least of all;" but that "when they are compared with respect to collective or demotic modification, it becomes manifest that the moveless plants are least, the moving animals more, and prevising men most profoundly modified."† It was found also that the collective modification tends through coöperation to the development of a solidarity in which the several organisms unconsciously or semi-consciously combine against the rigorous environment. Finally it was found that there are three stages in the coöperation of plants, animals and men, viz.: communality, in which the organisms stand together for mutual protection yet retain undiminished individuality; commensality, in which unlike organisms unite to the end that one or both species may be perpetuated; and agriculture, or the state in which intelligent organisms (especially ants and men) regulate the course of common development by exclusion of the perverse. Thus the earlier researches indicated not only that there is a reciprocal relation between biotic and demotic characters, but that, in a rigorous environment, the latter characters are found among nongregarious animals and plants as well as among men and gregarious animals. The researches also supplemented historical records proving that agriculture began in desert regions by showing the manner in which intelligent organisms are unavoidably forced into this highest grade of coöperation by desert conditions.

During the later expedition the researches concerning collective or demotic relations were continued. The observations among the Papago Indians were extended not simply to the relations between the human group and the sub-human assemblage, but also to the relations among the individuals and sub-groups of the human assemblage. The details noted are many and of a diverse character, and it must suffice at present to indicate their sum. In general, it was found that the continual struggle for existence under adverse conditions has tended to strengthen character among the human units, and to render each individual strong, self-reliant, resourceful, decisive, just as the plants and sub-human animals have been rendered long-lived and vigorous; but that this tendency toward the development of individuality is accompanied by an altruistic tendency under which the human units are brought into sympathy and union of exceptional closeness. In nomadic desert life individuals and small groups are constantly exposed to the risk of death by thirst, and occasion frequently arises for other individuals or sub-groups of the same assemblage or tribe to relieve the sufferers, and if this is done the assemblage is strengthened, while if it is not done the assemblage is weakened. So also isolated individuals are in danger of starvation, of attack by predatory animals, of poisoning by animals and plants, or of death in other ways, in a larger ratio than when several are in company; yet the character of the country is such that hunters, warriors and

*This term is used as a synonym of sociology in its widest sense, but with still wider meaning. It may be defined as the science of organizations, whether spontaneous or purposive, among organisms.

†'The Beginning of Agriculture,' op. cit., p. 374.

other travelers must journey far and in limited groups, and hence there is an incentive toward grouping by physical parity which is more or less independent of kinship or biotic affinity. Other tendencies also enter; but individually and conjointly they make for altruism, and eventually for a humanity and charity transcending family ties and gentile bonds. Now the characteristics of the Papago, as recorded by different observers during the last 350 years, comprise dignity and courage, docility and virtue, humanity and intelligence, hospitality and integrity; and these characteristics, which are akin to those of civilization, are among those toward which his hard environment tends. Thus it would appear that these people of the desert have been forced by environment toward civilization; and it would appear also that, just as the plants and animals have been hurried into the higher stages of phylogenic development by physical pressure, the Papago have been forced into civilized relations before acquiring civilized culture. The course of human development may be divided into two great stages characterized by distinctive modes of expression. The first is the prescriptorial stage in which ideas are thrown into crude and incongruous classes for mnemonic purposes; the second is the scriptorial stage in which ideas are expressed by arbitrary symbols, graphic and phonetic; and these stages are none the less veritable because the transition from one to the other has taken place gradually among many peoples; this transition being perhaps the most sweeping and important in the whole course of development of mankind. During the earlier stage, in which incongruous things are connoted, there has been among many peoples, notably the various American families, a custom of connoting kinship with tribal law; indeed tribal law is memorized and perpetuated largely through terms of relative position of individuals in the family, in the clan or gens, and in the tribe; so that among these peoples tribal law tended toward the perpetuation of kinship systems, and remembered kinship crystallized and perpetuated tribal law. Thus the basis of prescriptorial society ever smacked of nepotism and made for egoism rather than altruism. But in Papagueria, where the conditions led to the development of an altruism transcending filial, paternal and fraternal feeling, the consanguineous system seems to have weakened and the system of law bound up therewith seems to have dropped into desuetude, and the people seem to have risen to the moral plane of civilization without making the usually parallel transition from the prescriptorial to the scriptorial stage in the art of expression. It is impracticable now to develop this line of research in detail; it must suffice to note in passing that the observations and inferences indicate that civilization, no less than agriculture, must be reckoned among the products of the desert.

Although in many respects antithetic to the Papago, the Seri Indians are interrelated with their environment in various ways. Seriland proper comprises a large island (Tiburon, about 500 square miles in area) and several islets in the Gulf of California, with a several times larger area on the adjacent mainland; the entire tract is mountainous and exceedingly arid, only one feeble streamlet and a few small springs or tinajas existing within it; and it is clearly set off from contiguous habitable territory by a broad desert zone. From time to time the Seri steal across their bounding desert in predatory forays or for petty trade, and during the early history of western Mexico they established nominally permanent settlements so much as 75 miles beyond their natural boundary; but it has been their custom, always in case of defeat and commonly in the event of ordinarily

manful opposition to their predation, to retreat to their stronghold, which they have stoutly defended against invasion. There they subsist on abundant and easily obtained sea food, on the game of the subdesert mountain slopes, and in season on the fruits of cacti and other plants of the foot-hills; and since these sources of subsistence unfailing and easily reached through means shared with feral animals, the Seri tribesmen have ever been notably independent of other peoples and cultures, and this territorial dominion has remained an ethnic unit since the time of Coronado.

The Seri Indians display several more or less distinctive characteristics, both biotic or individual, and demotic or collective. Individually they are of superb physique, able to run down fleet game and capture half-wild Mexican horses without ropes or projectiles; able to run across the sand dunes and playas of their bounding desert, waterless and foodless, so rapidly as to escape pursuing horsemen; able to abstain from food and water for days; able habitually to pass barefoot through cactus thickets and over jagged rock slopes without thought of discomfort; able to gorge carrion and swill the reeking filth of shrunken tinajas without injury; typically they are trained athletes, strengthened against exercise, habituated against abstinence, hardened against pain, and inured against poison, all at the same time and all in remarkable degree. Considered as a demotic unit, the Seri are characterized by hereditary enmity toward alien peoples; for three and a half centuries they have been at war or on the verge of war with Spanish explorers and missionaries, with neighboring tribes, with Mexican pioneers, with American prospectors; they profess a passion for alien blood, always gratified save when they are deterred by fear; they are fiercely endogamous and the blackest crime in their calendar to-day is the infraction of this law; they speak a distinct language, apparently representing a distinct stock; so far as can be ascertained, their mythology is distinct; save for a few simple arts that seem to have been acquired through imitation, their culture is primitive, protolithic as to stone, nascent only as to customary and house-building, unborn as to agriculture, and well advanced only in connection with their reed balsas and the cords of vegetal fibre or human hair used in making them; their grade of coöperation or order of solidarity is below that of the farmer ant, below that of the yucca moth, not even on a par with that of the seed-scattering bird that has aided in giving character to a flora, for (except that they have domesticated dogs) they merely destroy and never propagate or otherwise aid associated organisms; collectively they are bitterly inimical to men, animals and plants, and are parasitic on a peculiarly conditioned tract to which they have adjusted physique and tribal custom. Considered as a group composed of interrelated individuals and subgroups, the characteristics of the Seri Indians include strong family ties, manifested especially in maternal affection and in their little-understood kinship system; firm conjugal bonds (despite modern polygyny due to repeated decimation of the warriors), displayed in their endogamy and in a singular marriage custom; fixed tribal union (despite internal dissension in the intervals of external conflict), revealed in community of property and interests especially in relation to alien peoples; and rigid adherence to custom, as exemplified in the crudeness of their arts, in their habit of locating camps and habitations far from fresh water, in their amor patriæ, and in many other ways, *i. e.*, their intertribal characteristics, like their physical attributes, are strongly individualized and tend toward tribal integrity, independence and isolation. History and archæology indicate that the characteristics of the Seri

have persisted long; for three and a half centuries they have been known as fierce and powerful warriors, tumultuous in battle and swift in retreat; reputed as users of poisoned arrows and perpetrators of repulsive atrocities in their endless and relentless warfare; regarded as Ishmaelites harboring in the fastnesses of a desert island (for the insular and continental portions of Seriland have never been clearly discriminated by neighboring peoples), whose bestiality placed them all but beyond the pale of human kind. There are indeed records of attempted conversion and subjugation among the rancherias overflowed from Seriland proper, but the assemblage of records is either contradictory or indicates that the converted and subjugated tribesmen weakened and died under the yoke of a higher culture; an apostate Seri resides in Hermosillo, another in Altar, and a third is said to live in California, but no other trace of Seri flesh or blood was found outside of Seriland. The testimony of ancient works is accordant with that of the writings; outside of Seriland there are prehistoric ruins indicating a succession of more or less distinct populations extending over many centuries; in Seriland there are no works save such as the Seri now produce, though some of these are impressively ancient.

While several of the characteristics of the Seri Indians are unusual and some (*e. g.*, their fleetness and endurance, their unique marriage custom, etc.) so singular as to challenge belief, the assemblage of characters is remarkably consistent and harmonious. The physical perfection of the warriors and their vigorous wives and fleet-footed children is in harmony with their mode of life and militant habit, as with all other characters; indeed they would be unable to survive, to capture strong swift and alert game, to traverse the long waterless stretches in their domain, to cross their bounding desert, without exceptional physique, which may thus be ascribed to survival of the fittest during the generations of development and adjustment to a peculiar environment. Their hereditary blood-thirst is consistent with their enmity toward animal and plant, with their primitive art, with their endogamy, with their linguistic independence, and with their physical characteristics; indeed warfare against other peoples is but an expression of disposition and habit manifested in many other ways. Their rigid endogamy and rigorous marriage custom are consistent with each other, with the long isolation of the tribe attested by history and archæology, with their linguistic distinctness, with their continuous warfare, with their abstemious habits, and with all their other characteristics; indeed their marriage custom would be inexplicable and incredible except in conjunction with their endogamy, while their conjugal relations taken collectively would appear incongruous among a more advanced people. Thus the leading characteristics of the tribe are mutually consistent and interrelated in such manner as to form a definite assemblage, of which no one could be modified without affecting the integrity of the whole. So, too, when the characteristics are considered in sequence or phylogenically, it would appear that each stimulates and combines with all the others in such manner as to render the development cumulative; and also that each feature and the assemblage of features are such as might normally result from the survival of the fittest in a peculiar environment. Finally it would appear that all of the characteristics of the Seri Indians, biotic and demotic alike, are adjusted directly or indirectly to an arid, mountainous land, bordered with a fruitful coast, and protected by a strong natural boundary, *i. e.*, to the actual Seriland, and that they could hardly have been developed under a different environment.

On contrasting the Papago and Seri In-

dians, it is found that many of their characteristics and their respective courses of development are widely diverse. The former are habitually at peace; the latter habitually at war. The former coöperate with men, animals and plants; the latter antagonize men, slay animals and destroy or neglect plants. The former developed the highest attributes of humanity to the extent that they met the Spaniards as peers; the latter remained robbers and assassins. The former produced arts, rose into agriculture, and at one time made conquest of the waters; the latter are perhaps the most primitive of American peoples. The former tribe is populous and probably increasing in number, despite the invasion of their territory by white men; the latter has been reduced to a handful and is destined to disappear, probably within a decade, almost certainly within a generation, perhaps within a year or two. In a few characteristics the tribes are similar, in certain respects their courses of development have been parallel; but the differences are more striking than the resemblances. Both peoples have been subjected to hard conditions with unlike, but not necessarily incongruous results; as among fishes the darkness of the deep sea may lead either to development or elimination of the eyes, so among men stress of circumstance may lead either to the growth or to the decay of humanity.

In considering the relations between tribes and their environment it is desirable to avoid a common and natural misconception to which attention has been directed by Powell. There is indeed a direct relation between the physical characteristics of the individuals composing the tribe and their environment, in virtue of which the hard environment tends, through survival of the fittest, to produce excellence of physique among men as among the lower animals; but among mankind this direct relation is overshadowed by an indirect relation passing through the institutions, arts, etc., of the human animal. The importance of this indirect relation is indicated by the generalization that the moveless plants are most, the moving animals less, and demotic mankind least affected by environment so far as purely physical or biotic characteristics are concerned, while the converse is true of the demotic characteristics. The same law is well illustrated by the Papago and Seri tribes. The Papago Indians were enabled to survive desert conditions by organization and by an assemblage of arts growing into agriculture; while the Seri, albeit of fine physique, have been enabled to survive only by tribal union, endogamy, a consistent system of warfare, and an assemblage of arts all adjusted to their habitat even more closely than the striking Seri physique is adjusted to desert-bound Seriland.

W J McGEE.

WASHINGTON, D. C.

NOTE ON THE PERMANENCE OF THE RUTHERFURD PHOTOGRAPHIC MEASURES.

ONE of the most interesting questions confronting practical astronomers at the present day is the question of how long the photographs which are now being accumulated in such great numbers will remain fit for measurement. To throw some light on this matter, I have caused some of Rutherfurd's Pleiades plates to be remeasured with the new Repsold measuring machine of the Columbia College Observatory. The present note is published in advance of the detailed account of the observations and their reduction, as the matter seems to be of immediate interest to astronomers. The measures have been carried out with great care by Mrs. Herman S. Davis and Mrs. Annie Maclear Jacoby. As measures of these same plates were made under Mr. Rutherfurd's direction by Miss Ida C. Mar-

tin soon after the plates were taken, in 1872 and 1874, a simple comparison with the new measures out to show whether the plates still admit of accurate measurement, and whether the positions of the star images have changed by an appreciable amount. It is to be noted of course that the Rutherfurd plates were made by means of the wet-plate process, using albumenized plates; so that the results of the present paper are not strictly applicable to the modern gelatine dry-plates. Yet it seems fair to suppose that the gelatine plates will be at least as permanent as those of Rutherfurd. In any case, the present research is of considerable importance because of the large number of Rutherfurd plates not yet measured, and the measurement of which would be useless if their precision has been seriously impaired.

It is therefore a source of congratulation that the new measures here described have not brought to light any such alterations of the photographic film as would invalidate measures made on the Rutherfurd plates twenty years after the date of exposure. In fact, we may say that in no instance does the difference between the new and old measure exceed such an amount as might reasonably be expected from the combined uncertainty of both. For the present purpose, I have not thought it necessary to re-measure all the plates treated in my paper on the *Pleiades* (Annals N. Y. Acad. of Sciences, Vol. 6, p. 239). Nor have all the stars been re-measured, since a few stars well distributed on the plate would undoubtedly bring any existing change to light. On the other hand, every care possible has been taken to make the measures as accurate as possible, except that the insignificant 'projection error' found by Donner to exist in the Repsold apparatus has not been taken into account. Of course this is of no importance in the work under consideration, because the elimination of the errors of projection would be almost certain to improve the average accord with the old measures. The same is true of any errors which may perhaps exist in the guiding cylinder of the Repsold machine, and which have also been neglected.

To avoid any possible bias in selecting plates for remeasurement, I determined to measure those plates to which even numbers had been attached by Rutherfurd at the time the plates were made. But we were unable to find plate number 20 among the plates deposited at Columbia College, so the remeasurement has been applied only to plates 16, 18, 22 and 24. On each of these plates eight stars were selected for remeasurement, distributed on the plate in a way well suited for bringing any disturbance of the images to light. After this work had been finished, it occurred to me that the stars selected were all fairly bright, and that it would be very desirable to measure some faint stars too. Accordingly six faint stars were selected, and were very carefully measured on plate 16. The stars Anon. 34 and 18 *m.* were used as standards on all the plates.

Inasmuch as the Repsold machine furnishes rectangular coördinates, whereas the Rutherfurd measures were in distance and position angle, it was necessary to compute the distances and position angles from the measured rectangular coördinates, before a direct comparison could be made. The following table contains the results of such comparison. In every case the ratio adopted for the quantity:

$$\frac{\text{Rutherfurd scale value}}{\text{New scale value}}$$

was such as would make the sum of the discordances in distance between the new and the old measures zero. Similarly, a constant was applied to the discordances in position angle, so as to make the sum of

these discordances zero. The discordances in position angle have been turned into arc of a great circle by multiplying them by the sine of the distance. For this reason the sum of the position angle discordances will differ slightly from zero, as the constant was applied before turning them into arc of a great circle. It should perhaps be remarked that the comparisons were made with the old Rutherfurd measures as printed in my paper on the *Pleiades*, already referred to, without the application of any corrections whatever. In conclusion, I wish to express my thanks to RUTHERFURD STUYVESANT, ESQ., who had placed at the disposal of PROF. J. K. REES, Director of the Columbia College Observatory, funds for the reduction of the RUTHERFURD plates. This has enabled the Observatory to secure the services of MRS. HERMAN S. DAVIS, who has relieved me of the very arduous labor of computation involved in the reduction of these measures.

TABLE OF DISCORDANCES,

RUTHERFURD MEASURES *minus* NEW MEASURES.

Star.	Plate 16.		Plate 18.		Plate 22.		Plate 24.		Means.		MAG.
	Angle.	Dist.	Angle.	Dist.	Angle.	Dist.	Angle.	Dist.	Angle.	Dist.	
A 34	0".00	—0".12	—0".24	—0".21	+0".07	+0".26	—0".20	—0".02	—".10	—".02	7.2
18 *m*	— .06	— .06	+ .12	+ .05	— .08	— .34	— .14	— .02	—.04	—.09	6.3
A 12	— .01	— .18	+ .40	+ .14	+ .16	— .10	+ .27	+ .13	+.20	.00	7.5
A 22	— .04	+ .27	— .06	— .08	— .06	+ .19	— .04	+ .06	—.05	+.11	7.0
A 24	— .02	+ .16	.00	+ .30	— .13	+ .10	+ .07	+ .30	—.02	+.22	7.0
A 28	+ .08	— .10	+ .18	— .13	— .12	— .13	— .14	— .43	.00	—.20	7.0
A 30	— .02	— .01	— .45	+ .08	+ .17	— .01	— .17	+ .00	—.12	+.02	8.4
A 39	+ .41	+ .03	+ .14	— .18	+ .39	+ .02	+ .20	— .01	+.28	—.04	7.7
A 34	+0".14	—0".15							+".14	—".15	7.2
18 *m*	+ .03	— .17							+.03	—.17	6.3
A 5	— .26	+ .06							—.26	+.06	9.1
A 6	— .05	+ .03							—.05	+.03	9.0
A 11	+ .04	+ .06							+.04	+.06	9.1
A 26	+ .19	+ .12							+.19	+.12	9.0
A 27	+ .03	+ .03							+.03	+.03	8.5
A 36	— .26	+ .02							—.26	+.02	8.5

COLUMBIA COLLEGE OBSERVATORY, March 10, 1896.

HAROLD JACOBY.

ANNUAL RECEPTION AND EXHIBITION OF THE NEW YORK ACADEMY OF SCIENCES.

THE New York Academy of Sciences held its third annual reception on the evening of March 16th, at the American Museum of Natural History. The reception included an exhibition of apparatus and specimens illustrating the progress of science during the year, and more particularly the work done by scientific men in and about New York. The exhibition in the afternoon was thrown open to students in the various educational institutions of the city, teachers and other persons interested in science, while the reception in the evening was attended by the members of the Academy and a number of guests. Both occasions were remarkably successful, the exhibits being of the same high character as have been shown at the previous receptions. The exhibition took place on the second floor of the Museum, which was kindly placed at the disposal of the Academy and was under the direction of Prof.

Henry F. Osborn, who was Chairman of the Committee of Arrangements. An innovation was introduced this year in having an address on recent scientific discovery and the large lecture room of the Museum was thronged by people eager to hear Prof. M. I. Pupin, of Columbia University, give an experimental demonstration of Röntgen photography. Prof. J. J. Stevenson, the President, also delivered an address stating the object and aims of the New York Academy of Sciences.

Among the many exhibits there were a number of unusual interest, as an effort had been made to include in the exhibition only objects illustrating recent discoveries or researches.

In the Astronomical section, which was under the direction of Prof. Harold Jacoby, there was exhibited a series of photographs lately made at the Harvard College Observatory. Prof. J. E. Keeler, of the Allegheny Observatory, contributed a series of photographs of planetary spectra. Prof. J. K. Rees exhibited some lantern slides and new instruments from the Columbia University Observatory. Prof. William Hallock, of the section of Physics, had collected in his exhibit a number of instruments and photographs connected with X-ray investigations. Several from Prof. Rood's laboratory showing the reflection of the rays and other phenomena; a series from Prof. Robb, of Trinity College, the most interesting of which was a record of the test of genuine and imitation gems, the real stones in each case appearing translucent; and a set from from Prof. Stevens, of Troy Polytechnic Institute, attracted considerable attention. Prof. Hallock's voice analysis apparatus was also shown and was accompanied by a number of photographs of vocal cords in action and the manometric flames. Prof. Pupin, the Chairman of the section of Electricity, exhibited a complete set of apparatus for producing the Röntgen rays, and by means of an Edison fluoroscope the penetration of the rays was shown. Prof. Pupin exhibited also a number of photographs he had taken and the apparatus he had devised for studying long electric waves. Charles T. Rittenhouse showed apparatus for studying the magnetic lay in closed magnetic circuits.

In the department of Chemistry the preperation of Argon and Helium was shown and the spectra of these two elements could be seen through spectroscopes. Under Photography the development of process work in colors and new apparatus occupied considerable space, while here also were to be found more Röntgen photographs, that of a boot and foot by Nikola Tesla being remarkably distinct. In the section of Geology Prof. Stevenson exhibited some interesting specimens, while Prof. J. F. Kemp showed specimens connected with recent researches by himself and his assistants at Columbia University. In the division devoted to Mineralogy, under the direction of E. O. Hovy, were exhibited some rare specimens contributed by a number of collectors and colleges. The phosphorescence of the diamond was shown by George F. Kunz, by means of a new apparatus. In the department of Physiography the most recent maps and models were exhibited in the charge of Prof. R. E. Dodge. The feature of the Botanical Exhibit was the topographical map of the New York Botanical Garden, which was exhibited for the first time. A number of preparations and studies were also shown, several of which were undertaken in the interest of the Revision Committee of the United States Pharmacopæia. The Torrey Botanical Club exhibited a series of valuable studies. This section was in charge of Prof. H. H. Rusby and Dr. J. K. Small. An interesting exhibit of aquaria was made in the Zoölogical section and preparations from the zoölogical department of Columbia University were

shown. A shin and skull of the fish-eating rodent Icthyomys-Stolzmanni from Peru was shown by the department of Mammalogy and Ornithology of the American Museum of Natural History and was said to be the second known specimen. Dr. T. M. Cheeseman, in the department of Bacteriology, showed some preparations from the Bacterial Laboratory of College of Physicians and Surgeons of Columbia, and there was exhibited by Prof. Henry W. Conn, of Wesleyan University, some morphological preparations of Bacillus No. 41, interesting for its power of ripening cream for butter. Prof. George S. Huntington, of the division of Anatomy, had an extensive collection illustrating recent work in human and comparative myology. In the section of Paleontology, in charge of Dr. J. L. Wortman, were exhibited a number of specimens from Wyoming, Utah and Dakota, collected by Messrs. Wortman and Petersen during the past year. The department of Geology of Columbia University exhibited a number of specimens obtained in their last summer's expedition.

In the department of Ethnology and Archæology the recent valuable additions that have been made to the collections of the American Museum of Natural History were exhibited. Prof. J. McK. Cattell, in charge of the Department of Experimental Psychology, exhibited a new apparatus for determining photometric differences by the time of perception. Some new apparatus from the Yale University Psychological Laboratory was exhibited by Dr. E. W. Scripture, while Prof. C. B. Bliss, of New York, showed a pendulum chronoscope.

HERBERT T. WADE.

COLUMBIA UNIVERSITY.

CURRENT NOTES ON ANTHROPOLOGY.

THE INDIAN AS A FARMER.

THE general statement that the Indian of the Eastern United States was when first discovered in the wild or hunting stage of development, must be considerably modified when we come to study his mode of life with care. He was in many parts of the land an agriculturist, a small farmer, and was by no means dependent entirely on wild game or natural products.

This has been forcibly brought out by Mr. Lucien Carr, in an article 'On the food of certain American Indians and their method of preparing it,' published in the Proceedings of the American Antiquarian Society for 1895. The author has examined the literature bearing on the subject thoroughly and his references are abundant and judicious. Within the compass of thirty-eight pages he has collected an amount of information which the student will scarcely find in larger volumes and much of which the archæologist, engaged in the examination of shell heaps and village sites, will do well to make himself acquainted with. His conclusion is that so far as the comforts and conveniences of life are concerned, the Indian was little behind the white pioneer who dispossessed him.

RACIAL PSYCHOLOGY.

IN his 'Anthropologie du Calvados,' recently published at Caen, Dr. R. Collignon calls attention to the statistics of the French population compiled by Jacoby and others, showing the relation of superior mental ability to descent. The method pursued was to make a catalogue for each department of all the distinguished men born in it for a century, without reference to the grounds of their celebrity, and then to note what proportion this bore to a million inhabitants. The differences are remarkable, varying from 690 in the department of the Seine (including Paris) to 13 and 14 to the million in Charente and Creuse. Normandy showed 106 per million.

When the several lines of activity were analyzed in which these became eminent,

marked contrasts were observed. The Normans were generally prominent in science, and little so in poetry or works of imagination; while this was reversed for the south of France. Dr. Collignon, therefore, comes to the conclusion: "To the difference of race, a purely anatomical fact shown by the shape of the head and the color of the hair, corresponds a difference in the brain, which reveals itself by a special tendency of the thoughts and particular aptitudes."

D. G. Brinton.

University of Pennsylvania.

SCIENTIFIC NOTES AND NEWS.

The annual stated session of the National Academy of Sciences will be held in Washington, D. C., beginning Tuesday, April 21, 1896, at 11 A. M. The place of meeting will be at the National Museum. In accordance with the new rule adopted October 30, 1895, the business meetings of the Academy will continue until one o'clock P. M. The scientific meetings will begin at half-past one P. M.

A bill has been passed by the Legislature of Maryland and signed by the Governor, entitled "An Act to establish a State Geological and Economic Survey and to make provision for the preparation and publication of reports and maps to illustrate the natural resources of the State, together with the necessary investigations preparatory thereto." $10,000 annually is appropriated for carrying out the provisions of the act, and a commission has been established composed of the Governor of the State, the Comptroller, the President of the Johns Hopkins University and the President of the Maryland Agricultural College. At a meeting of the commission, on March 25th, Prof. William Bullock Clark was appointed State Geologist. He will at once begin work in the field.

Brigadier-General Thos. Lincoln Casey died suddenly at Washington on March 26th. He was born on May 10, 1831, and had supervised many important engineering works and public buildings. At the time of his death he had charge of the new Congressional Library, one of the most notable buildings of the world. General Casey was appointed Chief of Engineers in 1888 and was retired in May, 1895. He was a member of the National Academy of Sciences, an officer of the Legion of Honor, of France, and author of many important articles and reports.

The privileges of the laboratories of the International Zoölogical Station at Naples have been extended to *seven* American students for the spring of 1896. At the present moment, however, there are only two American Tables, so that most of these men are accepted at the station through the courtesy of the director, Geheimrath Dohrn. The Smithsonian table has not remained unoccupied a single day since it was established, nearly three years ago, while Prof. Agassiz's table has also been in great demand. This country should have at least three tables at Naples. Who will assume the responsibility of raising the money for the support of a third table?

A marble bust in memory of the philosopher Luigi Ferri was placed, on March 16th, the anniversary of his death, in the hall of the University of Rome, where Ferri taught for twenty-four years. For this memorial about $200 had been collected by subscription.

Frank Weir & Co., New York, announce the publication of an *Index* to the medical press, to be published monthly, beginning the 15th of the present month. It is proposed to give a complete bibliography of papers published in the medical magazines and transactions of the United States and Canada.

Icones Plantarum, which has been edited by Prof. Daniel Oliver since 1891, will hereafter be edited by the director of Kew Gardens.

The French government has decided to continue to Mme. Pasteur the pension of 25,000 fr. which her husband had received for thirteen years.

Prof. Francis R. Fava, who held the chair of civil engineering at the Columbian University, Washington, died at that place on March 26th, aged about thirty-six years.

M. Berthelot, the eminent French chemist, has resigned from the Ministry of Foreign affairs of France.

A RESOLUTION has been adopted by the Senate permitting Prof. Simon Newcomb to accept the decoration of the cross of an officer of the Legion of Honor, and Prof. Asaph Hall that of chevalier, respectively, conferred on them by the French Republic, on the occasion of the centenary establishment of the French Institute, for services to the French Academy of Sciences as corresponding members.

THE Senate Committee on Public Buildings and Grounds has reported favorably the bill providing for the erection of an additional fireproof building for the National Museum.

THE department of geology and geography of Harvard University has placed on exhibition in Cambridge the Gardner collection of photographs, which consists of more than 3,000 mounted photographs and about 1,500 stereopticon views of geological subjects and landscapes, mainly purchased from the income of a fund established in 1892 by George A. Gardner, of Boston.

MR. M. A. LAWSON, government botanist in India and formerly professor at Oxford, died at Madras on February 14th.

MACMILLAN & CO. announce an English translation, by D. E. Jones and G. A. Scholt, of the Miscellaneous Papers of Heinrich Hertz, with an introduction by Prof. Lenard.

Nature states that Mr. Edwin Wheeler has presented to the Natural History Museum a valuable series of water-color drawings of fungi, 2449 in number.

IT is reported in the daily papers that locusts are doing much damage in South Africa. In Natal a 'chief locust officer' has been appointed and $35,000 has been spent in the attempts to check the plague.

THE German naturalist John Gundlach has died in Havana. According to the New York *Sun*, Gundlach was born at Marburg, Hesse-Cassel, in 1810, where his father was a professor in the University. He published in his native country some notable articles on natural history. The wealthy Cuban, Mr. Booth, proposed to him to come to Cuba and write a book on the natural history of the island. Mr. Gundlach accepted, and in 1839 he landed at Havana, and never returned to Europe, except for short visits. In 1844 he began his collection of Cuba's fauna, now preserved at the institute in Havana, and valued at over $200,000. He completed it in 1856. In 1873 and 1875 he went to Puerto Rico, to gather final materials for his book on the fauna of both the Antilles. Mr. Gundlach was also the author of a work on Cuban ornithology.

DR. A. W. BEKETON, professor of botany in the University of St. Petersburg, has retired, owing to ill health.

Nature for March 12th and 19th contains extended and appreciative articles reviewing the recent work of the U. S. Geological Survey.

AT the anniversary meeting of the London Chemical Society, on March 26th, the President, Mr. A. G. Vernon Harcourt, was expected to give the annual Presidential address before the Society.

MR. BERNARD RICHARDSON GREEN, who succeeds General Casey as Superintendent of the construction of the Congressional Library building, has been his chief assistant in all his great engineering enterprises, and was responsible for many of the brilliant and novel devices employed in the critical task of completing the Washington Monument, and replacing its old foundation by a new one. He is a graduate of Harvard University and is Recording Secretary of the Philosophical Society of Washington.

THE nomination of John J. Brice, of California, for Commissioner of Fish and Fisheries was confirmed by the Senate on March 25th.

A RECENT act of the British Parliament provides for the opening of the Government Museums for a portion of each Sunday. It provides that no employee shall be required to be on duty more than six days in the week and that those who have scruples against Sunday service shall be excused from attendance on that day.

MR. HIRAM S. MAXIM has written a series of articles on the evolution and manufacture of Automatic Firing Guns, the first of which appears in the current issue of *Industries and Iron*.

MR. THOMAS A. EDISON has invented an improved form of the fluoroscope proposed by Prof. Salvioni, and at about the same time by Prof. McGee, of Princeton University. In this instru-

vote themselves to some special and graduate work.

4. The securing men of distinction to lecture, and for a time to reside at the University.

These uses of the fund are not made absolutely binding upon the trustees for all time, but the donor expressed a desire to make the gift as flexible as possible in its application, recognizing the fact "that gifts to universities hemmed in too closely by restrictions are liable to lessen in value as time goes on."

In pursuance, however, of the end in view in the foundation, definite action has been taken in the establishment of a considerable number of Graduate Scholarships and Fellowships. The recommendations which were made regarding these have been approved and will now go into force. There are eight Graduate Scholarships giving free tuition and $100 open to those coming from the liberal courses in the College of the University; and there are, with the Hector Tyndale Fellowship in Physics, now fifteen fellowships, fourteen of which, coming from this Foundation, are open to students of any university. The amount of the tuition deducted from the full value of the Fellowship ($600) does not go into the general funds of the University, but may be used for the purchase of books or apparatus which will aid the student in his work, or may be used in the publication of theses.

A somewhat unusual feature is the establishment of Senior Fellowships, open only to those who have taken the Doctor's degree in the University of Pennsylvania. This amounts to the introduction, in a modified form, of the 'Docent' system of German universities, the object being not at all to use the Senior Fellow as a teacher for the sake of the value he may be to the University, but to test him and give him an opportunity to do a little teaching in the direct line of his special work. From the Senior Fellowships there is no reduction for tuition. This gives eight Graduate Scholarships, fifteen Fellowships and five Senior Fellowships, making twenty Fellowships in all. Fourteen of the Fellowships are open to men from other institutions, but the Senior Fellowships are limited to those having taken the Doctor's degree from the University in order that some of the best men may be kept in residence here as long as possible, and their influence felt among the students.

The whole plan aims at building up a cultured group of men interested in the advancement of knowledge and who shall be in residence at the University. Probably most of them will live in the dormitories, and their influence will undoubtedly be for good in the institution. The whole time of every incumbent of a Fellowship or Scholarship must be given to his scholarly work at the University.

GENERAL.

MR. W. C. MCDONALD, a tobacco manufacturer of Montreal, has given $500,000 to McGill University for the purpose of providing a building for the study of chemistry, mining and architecture. This brings his gifts to this university up to $2,000,000.

MR. F. C. MACAULEY, of Philadelphia, has bequeathed to the University of Pennsylvania his library, $5,000 for the purchase of books relating to Dante and Tasso, and $5,000 for archæological researches in America. The bequest to take effect on the death of his brother.

THE name of the University of the City of New York has been changed to New York University by the Board of Regents.

DR. O. CONE has resigned the Presidency of Buchtel College.

PROF. EARL BARNES and Prof. Ewald Flügel, of Stanford University, and Prof. Bernard Moses, of the University of California, are each to deliver a series of fifty lectures at the University of Chicago during the spring term.

DISCUSSION AND CORRESPONDENCE.

CERTITUDES AND ILLUSIONS.

MAJOR POWELL, having escaped (but temporarily, I fear) from the metaphysicians, has courageously entered the camp of the physicists in his paper of March 20th. Now the latter, as a class, are proverbially a simple-minded people, given rather to 'Certitudes' than to 'Illusions' and, as a rule, especially anxious to know what they are talking about, when they talk. They have a distinct fondness for the use of words whose meaning is precise and not

ment paper is covered with the fluorescing substance, and the shadows produced by the X-rays may be directly seen. The instrument has the general form of a stereoscope. Mr. Edison uses tungstate of calcium, with which it is said it is possible to see the shadow through three feet of cork.

M. Becquerel has reported to the Paris Academy that he has found that potassium uranyl sulphide when excited to phosphorescence gives rise to rays which last many hours (more than 160) after the phosphorescence ceases, and pass through paper aluminium and copper. They also discharge electrified bodies in a manner similar to the X-rays.

A series of field lessons on 'Birds in the Bush' will be given by Mr. Ralph Hoffmann, of Belmont, Mass., on Saturday mornings of April, May and June, in the neighborhood of Cambridge and Arlington, Mass. The object of the course is to indicate the easiest means of distinguishing the common birds native to this region, and the more interesting of the migrants. The songs of the different species, their favorite haunts, their feeding habits, and the sites chosen for their nests, will be studied. Before each walk, skins of the birds likely to be found will he examined. By beginning about the middle of April students may learn many of our common birds before the rush of migrants in May, and by continuing into June may pursue the study of our native birds after the migrants have passed.

A committee from the New York Chamber of Commerce has been organized to promote the efficiency of the medical library in the New York Academy of Medicine. An attempt is being made to collect $100,000 for the library. The library of the New York Academy of Medicine is one of the most complete in the world and is open, without charge, to all wishing to use it.

MM. A. and L. Lumière have invented an improvement on Edison's kinetoscope, which they call a cinematograph. With this instrument changing scenes are exhibited in their natural size on a screen. The groups, such as a crowd of people passing along the street or a railway train entering and stopping at a station, are said to be very effective. Some nine hundred instantaneous photographs are taken in the course of a minute, and when these photographs are thrown on a screen by means of the electric light at the same rate and order as they were taken an exact reproduction of the moving people is obtained.

The University of the State of New York has recently issued Museum bulletin 14 on the *Geology of Moriah and Westport Townships, Essex County.* Besides describing the general geology of these townships, this contribution to our knowledge of the magnetic iron-ore deposits of the United States discusses in detail the iron-ore bodies of that region, gives the latest information on its important iron-ore deposits and reviews the probable hypotheses as to their origin. It contains a geologic map of the two townships, a map of Mineville iron region, and half-tone views of the mining district and sections of the ore bodies. The bulletin is mailed postpaid to any address by the State Library on receipt of 10 cents. Bulletin 15 on the *Mineral Resources of New York*, by Dr. F. J. H. Merrill, director of the Museum, is nearly ready and will be mailed postpaid for 40 cents.

UNIVERSITY AND EDUCATIONAL NEWS.

GRADUATE SCHOLARSHIPS AND FELLOWSHIPS IN THE UNIVERSITY OF PENNSYLVANIA.

A large number of Graduate Scholarships and Fellowships are about to be established in the University of Pennsylvania. Provost Harrison gave to the University last June, as stated at the time in this journal, the sum of $500,000, to be held as a special fund, and to be known as the 'George L. Harrison Foundation for the Encouragement of Liberal Studies and the Advancement of Knowlcdge.' The purposes of the fund were described in the deed of gift as follows:

1. The establishment of Scholarships and Fellowships intended solely for men of exceptional ability.

2. The increasing of the Library of the University, particularly by the acquisition of works of permanent use and of lasting reference to and by the scholar.

3. The temporary relief from routine work of professors of ability in order that they may de-

whom he obtained information.* This is the more regrettable because the similarity between Dr. Ortmann's conclusions and my own is more manifest than that between his and any other investigator's.

The differences between Dr. Ortmann and myself chiefly result from our different modes of approaching the subject. Dr. Ortmann prefers the deductive mode and teaches that "we are to disregard each definite group of animals, and to investigate only the *physical* conditions influencing the distribution."† I prefer the inductive mode and have been influenced mainly by the consideration of the assemblage of the several groups of animals.

Dr. Ortmann, in accordance with his views, recognizes five 'life-districts,' distinguished as follows:‡

"1. Light. The medium is air. Substratum present. Terrestrial district.

"2. Light. The medium is fresh water. Substratum present. Fluvial district.

"3. Light. The medium is salt water. Substratum present. Littoral district.

"4. Light. The medium is salt water. Substratum wanting. Pelagic district.

"5. Dark. The medium is salt water. Substratum present. Abyssal district."

While there is a symmetry in these definitions that may be attractive, analysis will demonstrate that the 'districts' themselves are of very unequal value. In fact, they are framed in contravention of another principle enunciated by Dr. Ortmann: "The topographical continuity of the range is a fundamental principle influencing the dispersal of animals."§

Now, there is no greater interrupter of topographical continuity for land or fresh water animals than wide intervening oceans, and inasmuch as such land areas, with varying limits, have existed for long geological periods, they have been more effective barriers to extension of inland life than the differences connected with the several districts whose 'medium is salt water.' The land and fluvial faunas have consequently been long differentiated and, although in every age there has been doubtless an invasion from the sea into the rivers, the bulk of the fresh water forms in most regions has been long settled and specially developed as such. The districts in question must therefore be segregated under two primary categories, MARINE and INLAND.

But the marine districts still left are likewise of very unequal value. They are distributed by Dr. Ortmann as follows:

"I. Littoral life-district. 1. Arctic region. 2. Indo-Pacific region. 3. West American region. 4. East American region. 5. West African region. 6. Antarctic region."

"II. Pelagic life-district. 1. Arctic region. 2. Indo-Pacific region. 3. Atlantic region. 4. Antarctic region."

"III. Abyssal life-district. No regions distinguishable."

These 'districts' and 'regions' would answer well to divisions which I have established as follows:

I. Arctalian realm (1875) = I, 1.

II. Tropicalian realm = Tropical zone (O.), I, 2+3+4+5.

III. Notalian realm (1875) = I, 6.

IV. Pelagalian realm = II.

V. Bassalian realm = III.

These combinations appear to me to better represent the facts known respecting the distribution of marine vertebrates as well as invertebrates. The first three were distinguished as early as 1875,* but not named till 1877.† Later I deemed it advisable to subdivide the Arctalian into Arctalian (restricted) and Pararctalian and the Notalian into Antarctalian and Notalian (restricted). I also added the Bassalian and still later the Pelagalian. The Pararctalian and Notalian proper have less value than the others, except the Pelagalian, which is the least specialized of all.

I have thus pointed out the chief differences between Dr. Ortmann's views and my own. Naturally, from the difference in our starting points, ensuing differences are great. Dr. Ortmann's method leads to a consideration of 'life

* Grundzüge, p. 59.
† Pr. Coll. Bull., VII., 103.
‡ Pr. Col. Bull., VII., 101.
§ Pr. Col. Bull., VII., 102.

* On the geographical distribution of fishes, *in* An. Mag. Nat. Hist. (4), xv., 251–255, Apr., 1875.
† Wallace's Geographical Distribution of Animals *in* Nation, xxiv., 27, 28, 42, 43, July 12, 19, 1877.

open to dispute and, with their brethren the mathematicians, generally prefer to begin a discussion by defining the terms they are about to use, unless such terms are already so restricted and definite in their meaning as to cause no doubt.

Failure to pursue this course is the basis of much idle talk and meaningless controversy, especially at the present time.

People are everywhere talking about an 'honest dollar,' or 'sound money,' without stopping to ask what a dollar *is*, or what is meant by 'money,' or a 'standard of value,' without inquiring what *is* 'a standard and what is meant by value,' and all of this to the confusion of many who would like to give serious thought to important subjects. As Major Powell's philosophy is to furnish a basis for the elementary concepts of physical science, he will not, I am sure, take it amiss if he is asked in the beginning to define with some care the principal terms of which he makes use. No physicist can fail to read his last paper with much interest and, it may be added, with no little astonishment. To one accustomed to the rather simple perspective of the so-called exact sciences, there is a sort of mistiness and obscurity in it which suggests an 'impressionist's' view of the subject.

It is true that in the beginning definitions of 'body,' 'particle,' 'molecule,' 'atom,' etc., are given, which are quite satisfactory as representing the meaning which the author proposes to attach to these words. But the physicists are put entirely out of the controversy by the failure of the author to tell or even hint at what he means by that which is the text of the whole paper, namely, *motion* itself. Major Powell undertakes to show that "motion is persistent," that it "cannot be created or annihilated," and he even goes so far as to declare that this has been demonstrated to the satisfaction of a great body of scientific men. He speaks, often, of 'motion as speed,' thus creating an anxiety to know what 'motion' is when it is not 'speed.' By 'speed' he evidently means 'velocity' as independent of direction, and he declares that 'motion as speed' is 'inherent in matter' and is not imposed upon it from without, from which it necessarily follows that it cannot be transferred from one system to another. Acceleration, he then says, must be considered as 'deflection' or change in that element of motion which is 'direction,' and not in any correct sense a change in velocity. No one will deny a considerable ingenuity in reaching this conclusion, but there are a few obstacles in the way which Major Powell will doubtless easily sweep aside, some of them being suggested in the following questions:

1. What is motion?
2. What is rest?
3. If by 'motion as speed' is meant 'velocity,' and if by its 'persistence' is meant invariability of velocity, what possesses this invariability?—bodies, molecules, particles, atoms?—and *in reference to what* is the velocity constant?
4. As a molecule is considered as a 'body' when reference is had to the atoms which compose it, can it have an 'invariable velocity' as a molecule and variable velocity as a 'body'?

Many other doubts suggest themselves which will probably be quieted by the answers to these questions. I cannot refrain from expressing a hope, however, that in addition to these answers, Major Powell will kindly furnish an explanation of what he means when he says that the transmission of light at the rate of 299,878,000 metres per second furnishes an example of 'particle motion at a velocity so great that any observed molecular motion sinks into insignificance.'

M.

March 23, 1896.

PRINCIPLES OF MARINE ZOÖGEOGRAPHY.

I have been much interested in the admirable review, by Dr. Baur,* of Dr. Ortmann's 'Grundzüge der marinen Tiergeographie,' which I had only previously known from the 'summary' given in 'the Princeton College Bulletin' (VII., pp. 100–107); since then I have had the pleasure of receiving the work itself from the learned author. I find similarity in some features and difference in others between the views of Dr. Ortmann and my own. My contributions to zoögeography appears to have been unknown to Dr. Ortmann, except at second-hand, although exact references were made to publications by Dr. Faxon (p. 233), through

*Science, N. S., III., 359–367, March 6, 1896.

districts' as affected by their animal inhabitants; mine to the aggregations of animals according to their habitats.

The differences are counterbalanced by the resemblances in other respects. Let me close then by endorsing the favorable criticism of Dr. Ortmann's work by Dr. Baur and commending it as well worthy of attention.

THEO. GILL.

RÖNTGEN RAY EXPERIMENTS.

EXPERIMENTS with Röntgen Rays have been carried on very persistently at Case School of Applied Science for several weeks, and some very interesting results have been obtained. The main object has been to secure good photographs of the human skeleton in a living subject, and to increase the practical efficiency of the apparatus. The accompanying photographs of the bones of the hand and forearm, and of an aluminium medal, will indicate the degree of success obtained.

The arm was photographed with an exposure of twenty minutes, while the medal ($\frac{1}{16}$ inch thick) required but five minutes. The Crookes tube used is of the well-known spherical form, having four electrodes, designed to show that the discharge in a high vacuum is independent of the anode, and is one of a set which was exhibited at the World's Fair. It was excited by an induction coil giving about a six-inch spark in air, when using a current of three amperes and twenty volts, obtained from eleven cells of storage battery. The arm was held by bandages to the plateholder, which was supported in an inclined position upon a special stand. The usual plateholder slide of hard pasteboard was between the hand and plate. The tube was placed at a distance of twelve inches above the wrist. Rapid plates were used and developed in the usual way with eikonogen and hydrochinon developer. Slow lantern slide plates give nearly as good results, indicating that the sensitiveness of the plate to ordinary light is no criterion in this work. A great deal of detail appears plainly during development which disappears in the 'fixing' process. Various kinds of developers and fixing agents have been tried to overcome this, without success.

A photograph showing the bones of the fingers has been made with ten seconds' exposure, the tube being two inches above the plate. The bones of the entire arm, including the shoulder joint and of the foot, have been satisfactorily photographed. Attempts have been made to photograph the chest and head with exposures of one hour in each case, the tube being eighteen inches from the plate. The resulting negatives show a surprising amount of detail, which is too faint for satisfactory reproduction. The chest picture shows eight ribs on each side of the spinal column, a dark streak in the latter corresponding to the spinal cord. Under the region of the heart the ribs do not show, indicating that the heart is more opaque than the lung tissue. The collar bone is prominent, while the details of the shoulder joint can be seen. The picture of the head shows the following details: The spinal column in the neck, the jaw bones, with teeth and spaces where several are missing, the nasal cavities, the thickening of the bone showing clearly the outline of the ear, the thin places at the temples, the floor of the brain cavity and the ragged edge where bone and cartilage join in the nose. These pictures, though of little surgical value, are very interesting experimentally. Some of the negatives made clearly show the ligaments connecting the bones at the joints, while none have so far shown any blood vessels or nerves.

Bullets have been located in the hands of four men, and numerous cases of hands injured by machinery and of deformities have been examined, the exposures varying from two to twenty minutes. Some very interesting and valuable pictures of diseased arm bones and of fractures of the arm have been taken. In one case four inches of the arm bone had been removed five years ago, and the extent of the disease is clearly shown. Views of the fractures where the ends of the bones are not in apposition are of value to the surgeons. These photographs are taken through bandages, splints and silicate of sodium casts without hindrance.

A most interesting study has been the position of the various small bones of the wrist in different positions of the hand.

Many interesting points are noted in the work, which are suggestive in a theoretical way, details of which are not ready for publication.

As already announced by Prof. Rowland, it appears that the anode is as important in the matter as the cathode. We have a number of tubes which give results, but none better than the one mentioned, while a tube just received, of American manufacture, promises to equal the imported ones.

The success so far obtained with the arm and chest encourages us to think that still thicker portions of the human body may be studied advantageously, and experiments will be immediately undertaken in this direction.

DAYTON C. MILLER.
CASE SCHOOL OF APPLIED SCIENCE,
March 25, 1896.

[The photographs referred to by Prof. Miller, like all others of a similar character, are difficult of adequate reproduction by photogravure. The bones of the wrist and the large bones of the forearm are splendidly shown and the aluminum medal shows detail nearly as well as an ordinary direct photograph. T. C. M.]

THE INVERTED IMAGE ON THE RETINA.

I CANNOT justly take to myself the severe remarks which Prof. Brooks makes, in the last number of SCIENCE, concerning those who have understood him to mean that there is something peculiarly inconceivable in the *inversion* of the image on the retina; I did not myself take this view, because I happened to know, before writing my letter, that he disavowed this interpretation of his words. I even fail to understand by what rule of logic he drew the conclusion that he was the distinguished scientist to whom I alluded when I used these words: "Prof. Brooks can hardly hope that there should be any consensus among scientific men in regard to * * * * * *consciousness*, if *there are still distinguished scientists* who think that there is anything which needs explanation in the fact that the image on the retina is inverted." (I add the italics now.) This view of the matter is not uncommon, as the following instances, in addition to the discussion which has been going on for more than six months in SCIENCE, and which Prof. Brooks has found so wearisome, will indicate. A physician who had been travelling among the Esquimaux recently reported before a medical society in Philadelphia that those people are in the habit of holding a picture upside down when it is given them to look at; he accounted for this curious fact by supposing that they were in such a low state of development that they had not yet learned to reinvert the image on the retina, and this hypothesis was seriously discussed by this body of physicians, without having its absurdity pointed out by a single member. As another instance, I mention that a prominent Baltimore physician, in writing on the sensations of infants, lately said that they see everything upside down at first, and only learn afterwards to correct this impression.

Since Prof. Brooks has included me among those who have failed to take his meaning as he intended it, he cannot complain if I come to their defence in a single word. He had said: "We all believe many things that are inconceivable, such as the truth that the image in the retina is upside down;" and again, "I illustrated, by the inversion of the retinal image, the fact that evidence may furnish conclusive proof of truths that are inconceivable." Now, while it is true that "if, for purposes of illustration, I declare my conviction that the moon is not made of green cheese," no one has a right to infer that I think the moon is made of cheese of any kind, this supposititious assertion offers no analogy to the case in hand. If a person said that he could not believe that *the cheese of which the moon is made is green*, and also that he was not able to believe in the *greenness of the cheese of which the moon is made*, he would be using expressions precisely analogous to those made use of by Prof. Brooks in the case of the retinal image. Would anyone be expected to use language like this, unless it was the greenness only that troubled him?

C. L. F.

NECESSARY AND SUFFICIENT TESTS OF TRUTH.

EDITOR OF SCIENCE: When Prof. Brooks says that it is a 'great law of logic that the test of truth is evidence and not conceivability,' he uses the phrase 'test of truth' in a loose way which (while it is not uncommon), in the interests of logic, I must protest against.

To the mathematician it has long been a

thing which he has at his finger's end to make the distinction between the *necessary* and the *sufficient* condition for the truth of a statement, and there is no reason why other scientists should not speak with the same precision. One thing is the *necessary* condition for the truth of another, if the latter cannot be true in its absence; it is the sufficient condition, if it must be true in its presence. It may be matter of question whether 'test of truth' should be used in the sense of necessary or of sufficient condition of truth, but it certainly should not be used in both senses in the same sentence. 'Evidence' is the *sufficient* condition for the truth of a statement, but it is not in every instance *necessary*. I need no evidence to convince me that I am conscious. Now those who regard conceivability in the way that Prof. Brooks objects to, do not for a moment consider it to be a *sufficient* condition of the truth of any statement, but they do consider it to be the *necessary* condition of the truth of every statement. The inconceivability of a statement is for them the sufficient test of its falsity, and its conceivability is the necessary test of its truth. Instead of saying, therefore, with Prof. Brooks, that *the test of truth is evidence and not conceivability* (a statement which gives me a slight feeling of dizziness), it would be better to say that *the test of truth is evidence, and inconceivability is no criterion* (or test) *of falsity*, provided the exact terms, necessary and sufficient, should be considered too pedantic.

I have used the terms *necessary* and *sufficient* because they have been consecrated to this purpose by the mathematician, but I believe that *essential* and *sufficient*, or perhaps *requisite* and *sufficient*, would convey the meaning much better for ordinary language. We should then say, *evidence is a sufficient test* and conceivability is not a requisite test of truth.* The sentence "conceivability is not a necessary test of truth" is somewhat ambiguous; it might mean 'is not a test such that the truth necessarily follows from it,' instead of 'is not a test which it is necessary to have fulfilled if the truth is to hold.' But 'requisite test of truth' is not open to any ambiguity.

* That, for nearly all truths, evidence is also a requisite test, is true, but is denied by no one.

I am convinced that if the terms requisite and sufficient (or something equivalent to them) were to come into common use as defining the *kind* of ground, reason, argument, condition or test that the writer has in view, it would conduce very much to facility of comprehension on the part of the reader. M. M.

THE TEMPERATURE OF THE EARTH'S CRUST.

Mr. Sereno E. Bishop, in his letter in Science, March 13th, remarks that it would be interesting to ascertain what are the rates of increase of temperature now under regions where the subsoil is permanently frozen, as in the tundras of Siberia and Alaska.

Attention may here be called to the Report made to the British Association in 1886, by the committee appointed to organize a systematic investigation of the depth of the permanently frozen soil in the polar regions. Of some twenty-two localities mentioned in that Report, Jakutsk, Siberia, lat. 62°, is perhaps the most noteworthy, the limit of the frozen soil being 620 feet and the temperature rate 1° for 28 feet.

The transcendental formula employed by Lord Kelvin in his well-known chapter on the 'Cooling of the Earth' furnishes results in marked harmony with the temperature rate as determined by many observations. (Prestwich, Proceedings of the Royal Society, 1886.) It does not logically follow, of course, that Lord Kelvin's premises are necessarily correct. However, whether we accept the argument in the 'Cooling of the Earth' or rely on observations alone, we must for the present regard 1° F. per 50 feet (approximately) as expressing the law of the rate of increase of the temperature of the earth's crust near the surface; some local factor should be looked for as the cause of such an exceptionally low rate of increase as that found in the Calumet mine, or such a high rate as that in the Jakutsk mine. In any case it is scarcely safe to assume, as Professor Agassiz seems to do, that the rate observed to the bottom of the Calumet mine holds to the depth of 19 miles and beyond, and thence to conclude that the earth's crust has a thickness of 80 miles. The crust of the Lake Superior region may have counterbalancing abnormal features, so that the low temperature rate for the first mile is amply

atoned for before Lord Kelvin's 100,000 feet level is reached.

As regards Mr. Bishop's ice-cap hypothesis, would not an ice cap, on account of the low conductivity of ice, have the effect of raising the temperature rate instead of lowering it?

ELLEN HAYES.

WELLESLEY, MASS., March 18th.

THE PREROGATIVES OF A STATE GEOLOGIST.

EDITOR OF SCIENCE: As is well known to many of the readers of SCIENCE, the writer of this note spent the greater part of five summers in Missouri, studying the crystalline rocks and associated formations over an area about seventy miles square in the vicinity of Pilot Knob, and has published a number of papers concerning them. While Winslow was State Geologist I published the first half of Bulletin 5, and sent in manuscripts to accompany the Iron Mountain sheet, the Mine la Motte sheet, and my final report, which was to constitute a monograph, the last manuscript leaving my hands in August, 1893. The Iron Mountain sheet was engraved and proof sent me for my final revision of the geological boundaries, as was also the proof of my part of the accompanying text, before Winslow left the position of State Geologist, while as early as March, 1892, the Mine la Motte sheet was drawn and I marked the geological boundaries on it, although it has not yet been published.

Shortly after assuming control of the State Survey Office Dr. Keyes wrote me that he would soon take up the manuscript of my final report. On September 23, 1894, he wrote me as follows:

"Since looking over your MS. rather carefully I have come to the conclusion that it would be best perhaps for me to write an introductory chapter on the general geology of the region. We have now so much new material on hand in this direction, and the topographical sheets and reports on this have been completed this summer and are now ready for the printer, so that it would greatly enhance the value of the report to incorporate this work. So much more also is known in regard to the Cambrian since I have made a trip into the region. * * * I will revise the I. and II. chapters, if you are willing, *so as the introductory will not cover the same ground*; so you need not give these chapters much attention." (Italics are mine.)

Knowing the facts regarding the preparation of the sheets as above stated, it is difficult to understand how so much 'new material' could have been gathered in so short a time.

I wrote him in substance in reply to his letter of September 23, 1894, that of course he could write any introductory matter he chose, but that I very much hoped he would not borrow too freely from my manuscript in so doing. On January 29, 1895, he again wrote me:

"Regarding the other part of your letter I can assure you that I do not wish to detract one iota from the work or to deprive you of any credit on account of changes which may be made. Before it is printed I will talk or perhaps 'write' the matter over with you."

The manuscript was finally sent me as Dr. Keyes had revised it, but my first two chapters had been so changed and so many positive errors introduced that I wrote the State Geologist it never would do to have it published in that form. The result was he visited me in April, 1895, and we talked the matters over freely, as I thought. He consented to every change I suggested excepting that he wished my original manuscript abridged more than I desired. During this conversation not a word was said or even intimated that the chapter on the general physiography was not mine. I told him certain of the geological discussions which he had introduced were so different from what I had written that I did not care to be responsible for them. But I never thought of this being his introductory chapter, as he said nothing about it, and as his name was not attached to it, although he called this the first proof. No further word on the subject was sent me, and I was given no chance to further read the proof, although only twelve hours from him by mail. On November 1, 1895, I received the publication which appeared as a part of Volume VIII. of the Missouri Geological Survey. Much to my surprise I found that the whole of the physiographic descriptions and much other matter which I thought was entirely mine appeared under his name without any intimation

that I was in any way responsible for it, even though he had previously written, "I do not wish to detract one iota from the work or to deprive you of any credit on account of changes which may be made." He wrote me October 30, 1895, stating that the publication was complete, and saying: "Owing to your objections regarding the introductory section, I thought it best not to impose its authorship on you and consequently I have assumed the responsibility of this section, *as it in no way covers the ground of your first two chapters, except in the case of one or two paragraphs.* You can, of course, publish these elsewhere if you so desire." (Italics are mine.)

Very naturally I felt that this was a bold case of plagiarism, and wrote him on the subject November 14th, in reply to which he wrote me on the 15th: "Altogether there are two and a half or three pages which are taken from you, as I have already stated" (earlier in this letter). How the 'one or two paragraphs of October 30th could grow to 'two and a half or three pages' by November 15th, and this after the publication was complete, is no more mysterious than other incidents which are of no interest to the public. In the same letter of November 15th, he wrote: "More than one-half of that section over which I 'hoisted' my name was written at the request of Mr. Winslow for my chapter on Missouri stratigraphy to accompany the Paleontology report, and this more than three years ago. * * * . At least one-fourth was written for Maryland granites at Baltimore nearly five years ago. * * *. This matter was taken bodily with no changes whatever except several locality names." How this corresponds with his statement of September 23, 1894, regarding 'new material' the reader can judge.

In order to show those interested the relation between my original manuscript and the part with his name to it, the following quotations are made, portions in brackets being my comments.

Extracted from page 84.

GENERAL GEOLOGY OF THE MISSOURI CRYSTALLINE AREA.

(By Charles R. Keyes.)

Geographical Distribution.

The massive crystalline rocks of Missouri are confined to the southeastern part of the State. They occur in irregular masses and isolated hills extending over an area 70 miles square, which is widely known as the Iron Mountain country.

(Then follow ten lines of dissimilar matter.)

Pilot Knob is approximately the center of the crystalline district. For a distance of perhaps a dozen miles in all directions from this point, the massive crystallines form the greater portion of the surface rock; while in an easterly direction they are practically continuous for more than twice as far.

(Which reaches Knob Lick and Fredericktown.)

Beyond the large central field the exposures gradually become less and less frequent. To the north they do not reach much beyond Bismarck. Northeastward they are found in in Ste. Genevieve county, 30 miles from Pilot Knob. On the east, hills of similar rock are abundant as far as Castor Creek. To the south they stretch away in large masses for many miles, with occasional outcrops as far as the boundary line of Butler county. To the southwest, they extend into Shannon county, and perhaps even beyond.

Extracted from Haworth's Manuscript.

GEOGRAPHY OF THE CRYSTALLINE ROCKS.

a. Boundaries.

The crystalline rocks of Missouri are irregularly distributed over an area nearly seventy miles square. The central portion of the area is in the vicinity of Pilot Knob. Here for a distance of from six to ten miles in all directions the Archæan rocks cover the greater portion of the surface, and to the east they are almost continuous for more than twenty miles, reaching as far as Knob Lick and Fredericktown.

Beyond this central area the crystalline exposures continuously become smaller and farther apart. To the north they reach beyond Bismarck, into township 36 N. On the northeast they are found in Ste. Genevieve county nearly thirty miles from Pilot Knob. On the east porphyry and granite hills are abundant as far as range 8 east, or as far as to Castor creek. To the south occasional exposures may be observed as far as township 27 N.

(Which is near the boundary of Butler county.)

To the southwest they extend into Shannon county, and even then it is quite probable the limit is not reached. * * *. To the west the area reaches in almost unbroken outlines to the East Fork of Black River, is quite prevalent to the Middle Fork, and numerous scattered hills have been found beyond; while to the northwest porphyry hills are found as far as Little Pilot Knob, * * in Washington county.

They stretch out to the west almost unbrokenly to the east fork of Black River; while numerous scattered hills continue even beyond the middle fork of the same stream. Toward the northwest similar rocks occur at short intervals as far as Little Pilot Knob, in Washington county.

(Five lines referring the reader to maps.)

The central and most extensive portion of the crystalline is, as just stated, in the vicinity of Pilot Knob and Iron Mountain, and occupies the median parts of townships 33 and 34, north, in ranges III., IV. and V., east of the fifth principal meridian, with occasional extensions much farther in several directions. The crystalline area is almost unbroken for a distance of 30 miles southeast and southwest of Bismarck, which is situated near the northern margin of the great central district. The other masses of similar rock are much smaller and are widely scattered.

(If a knowledge of such boundaries was possessed by anyone other than myself and those who read my manuscript, what a mistake for the State to pay out so many hundred dollars and for me to spend so many months' time in ascertaining them.)

Page 86.

PHYSIOGRAPHY.

Topography.

(A little less than two pages is of a general character which is relatively distinct from the manuscript).

Page 87.

The various types of rocks give such characteristic phases of topography to the different parts of the district, that the true lithological nature of the rock composing a hill may be readily inferred at a distance of several miles.

East of the great central mass of crystallines the country is comparatively level, or rather not so rugged as in the immediate vicinity of the porphyry hills. In passing still farther toward the border of the area, the topography continually changes; the porphyry is less frequently found in the valleys, and more and more of the hills is composed of limestone. The granites in various places form high, steep prominences. To the west the difference in the surface relief of the granite areas is even more marked. No less than four of the most conspicuous elevations here are made up of granite. One of these on the East Fork of Black river, in the vicinity of the 'falls' (plate iii.), connects with the long row of porphyry

(A little farther along five lines refer the reader to maps.)

First: The central and most solid portions of the Archæan is in townships 33 and 34 N, and in ranges III., IV. and V. E, with occasional projections in different directions reaching much farther.

(About a page and a half of manuscript follows here giving more details of boundaries.)

Page 4.

b. Topography.

(About one page of manuscript is passed here containing many facts mentioned in the printed part.)

Page 4.

A little farther to the east, in the big granite area, the country is comparatively level, or at least much less rugged than in the immediate vicinity of the porphyry hills. This is so noticeable that one may well speak of the characteristic topography of the granite areas. The few high hills that occur almost invariably grade into porphyry toward their summits. But as we pass towards the border of our area, in any direction, we find the topography changing. The porphyry is less frequently found in the valleys; an ever increasing proportion of the hills are composed of Cambrian rocks; and, strangest of all, the granites in different places become the constituents of high and steep hills.

(* * * Six lines of manuscript.)

To the west the difference in the topography of the granite is often more marked. No less than four prominent hills here are composed of granite, while the valleys are never covered with it. One of these is on the east bank of East Fork of Black river, in the vicinity of the beautiful and picturesque 'falls' * * *. (Here description is given in detail.)

The granite hill connects with a long row of prominent porphyry hills, but it is higher than any of them. The next most prominent one of the four lies to the north about three miles in the angle between the East Fork and the Imboden Fork. It is locally called 'High Top,' and well it deserves the name, for it stands out prominent above all the hills near it. According to the barometric measurements made by Mr. Kirk it rises 635 feet above the valley at its base, which shows that it compares favorably with Shepherd Mountain, the biggest and highest porphyry hill

hills, but is higher than any of them. Another is three miles north of the one last mentioned, between the East Fork and the Imboden. It is called 'High Top,' for it towers above all the hills surrounding it, rising 635 feet above the valleys at its base, and compares in this respect favorably with Shepherd Mountain, the largest and highest porphyry peak of the central area. The third principal granite hill lies to the south, and its height is about the same as the two mentioned; while the fourth is about a mile east of High Top. Farther west are still other crystalline hills, but they are composed of porphyry. Beyond the Imboden fork is another tributary known as Shut-in fork. The word 'shut-in' is a name usually applied throughout the region to every place in which two hills are close together with a stream flowing between. In this case the two hills forming the 'shut-in' are very high, particularly the westernmost, which rises 610 feet above the stream.

Throughout the Black river country there is unusual regularity in the courses of the streams; from which fact it may be inferred that there is a corresponding symmetry in the arrangement of the elevated portions of the region instead of promiscuous scattered positions of the hills so common elsewhere. There is a series of long rows of elevations between the streams. Generally the southernmost point of each is the highest, as in the case of Hightop and the other granite hills mentioned above. From the summit of any prominent elevation in this region there is visible every crystalline mass within a radius of many miles. Here and there may be noticed a prominence standing out more boldly than the others, and they often, after closer inspection, resolve themselves into rude ranges. The most prominent of these groups is in the vicinity of Annapolis. The row forms a broad curve extending to the southwest a distance of three miles. To the east and southeast there are first a few small porphyry hills in the immediate vicinity of the town, and beyond this a large elevation with three prominent spurs. These hills in turn stretch away to the southeast, almost connecting with the row of mountains on the east bank of Crain Pond creek, and from thence to Gray mountain immediately east of Brunot.

Page 89.

Southward from the point of view just mentioned, across a stretch of six or seven miles of lowland, is a second row of hills extending east and west and reaching from Black river to the St. Francois. On the west is Mann and on the southeast Rubel mountain. Both are large porphyry hills. Beyond the latter are McFadden, Aley and Mud Lick mountains, the latter in the central area. A third one of the four granite hills lies on the south line of the same township and will perhaps equal in height either of the two above mentioned, although its altitude has not been measured. The fourth one lies about a mile west of High Top, but is much less prominent.

(Here follows about one-half page giving geologic reasons for peculiar topography.)

West of the Imboden Fork is another tributary known as the Shut-in Fork. The two hills forming the so-called 'Shut-In'—a common term applied to almost every place where two hills are close together with a stream flowing between, are very high, particularly the west one. It rises to a height, according to Mr. Kirk, of 610 feet. * * * *

By consulting a map one will see that in the Black river country the streams come from the northeast and the northwest, converging to a point a little south of Lesterville, in Reynolds county. There is an unusually great regularity here in the direction of the water courses, which means there is a corresponding regularity in the topography of the country, a topography which may almost be named the Black river type. Instead of the irregular, hatchy arrangement of the hills, so common in other places, we find here at least an approach to regularity in the numerous rows of hills between the streams. Generally also, the southernmost point in each row is the highest, as is the case with High Top and the other granite hills mentioned above.

Standing on a prominent hill almost anywhere south of the north line of township 33, particularly in the Black river or the Taum Sauk country, by looking away to the south, one can readily distinguish almost every Archæan hill, each of which is porphyry, lying between the latitudes of Hogan and Piedmont.

('Many miles.')

The country is broken and hilly, but here and there may be noticed a much greater prominence, a hill which stands out so boldly that it at once attracts attention. These large hills, or mountains, as they are locally called, are so independent of each other in location that there seems to be little, if any, relation between them. But when they are platted it can be seen they constitute three distinct groups of hills.

('Rude ranges.')

The northern group is in the vicinity of Annapolis. The row of hills form a curve convex northward, with Annapolis just south of the curve. To the southwest the curve extends about three miles, including as many hills. To the east and southeast one passes a few small porphyry hills, immediately at the town, then Grassy mountain, a prominent porphyry hill * * *.

two rising 710 and 793 feet above the surrounding valleys. The last one is the larger of the two and consists of two separate peaks. The eastern base is washed by the St. Francois river.

Still farther to the southward from the point of vantage named are other hills which appear as an irregular row trending east and west. The westernmost is Finley mountain, a large peak covering nearly six square miles and reaching from the Iron Mountain Railroad on the east almost to Black river on the west. It rises 725 feet above the valley, and may be regarded as one of the largest prominences of the region. To the east is Clark mountain, the highest and the grandest hill in the whole area. It is conical in form and rises majestically to a height of 843 feet above its base. It may be seen from every prominent peak south of Iron mountain, and appears to rise so high above the surrounding hills that it almost seems higher than any of those to the north. Looking in that direction from Clark mountain, the whole country for a distance of thirty miles is visible, from Black river to Knob Lick. The interval between the two points rises as a wall upon the landscape. High Top and Shut-in mountains appear to the northwest, Shepherd mountain to the north, Black and Blue mountains to the northeast, with numberless intervening hills of almost equal height and nearly equal prominence.

One more district deserves special mention in this connection. It is along the St. Francois river below the Silver mines. The hills close in on each side, but usually allowing a valley wide enough to contain extensive farms, first on one side of the stream and then on the other, while at other places it narrows to a width scarcely sufficient to admit the passage of the river. The hills are very large. On the west bank are Black, King, Gray and Mud Lick mountains, with less prominent ones between. On the east bank are peaks which rise fully as high.

Page 90.

c. Drainage.

(Here follows ten lines quite dissimilar from anything in the manuscript.)

(Exact location given.)

Beyond this there is the large hill with its three southern projections

('Prominent spurs.')

* * *. This hill in turn stretches away to the southeast, almost connecting with a row of similar hills on the east bank of Crain Pond creek, and from thence to Gray's mountain, immediately east of Brunot.

Page 8.

If from the point of view before mentioned, or better, from a prominent point in the row of hills just located, one continues looking southward across a piece of relatively low land occupied by many hatchy chert hills, six miles or more away, one will see a second row of hills trending east and west and reaching from near Black River to the St. Francois. Beginning on the west we find Mann mountain *.

(Exact location given.)

To the southeast in Section 11 is Rubel Mountain, another large porphyry hill. Passing eastward still * * * McFadden's mountain is met with, and beyond it to the southeast Aley mountain and Mud Lick mountain, two large and high porphyry hills which measure respectively 710 and 793 feet above the surrounding valleys. Mud Lick mountain is the larger of the two and consists of two separate peaks.

(Three lines omitted.)

It's eastern base is washed by the St. Francois river.

Looking still farther southward other hills can be seen which, with a little imagination, will appear in an irregular row trending east and west. The westernmost one is Finley mountain, a magnificent hill covering nearly six square miles and reaching from the Iron mountain Railway on the east almost to Black River on the west. It rises 725 feet above the valley, and when compared with the hills in the Pilot Knob region, is one of the largest. Passing eastward from Finley mountain and disregarding the smaller hills, one reaches Clark mountain, the highest and grandest hill in the whole Archæan area. It is circular in form, and * * *. (Exact location given.) Its summit rises in magnificent grandeur to a height of 843 feet above the valley. It can be seen from every prominent peak south of Iron Mountain, and seems to rise so high above the surrounding hills that one thinks surely it is higher than any of those to the north. But, in turn, when standing on the summit of Clark mountain and looking to the north the whole country thirty miles away, from Black river to Knob Lick, seems to rise like a wall, or mountain chain, it is so much higher than the in-

tervening hills. From here one can see High Top and Shut-in mountain to the northwest, Shepherd mountain to the north, and Black mountain, Blue mountain and Knob Lick mountain to the northeast, with so many intervening hills of almost equal height that the prominent ones mentioned can scarcely be distinguished.

(Here follow eleven manuscript lines descriptive of topography south of Clark mountain.)

One more region should be especially mentioned in this connection, that along the St. Francois river below the Silver Mines. The granite area above described reaches down the river a mile below the old mining place bearing this attractive name. Here the hills close in on each side forming a narrow valley through which the river flows. In places the valley is wide enough to contain extensive farms, first on one side of the stream and then on the other, while in other places it decreases to width barely sufficient to admit the passage of the river. The hills are very large. On the west bank there is Black mountain, four miles long, King mountain, Gray's mountain, and Mud Lick mountain, with less noted ones between. On the east bank we have hills almost as extensive whose peaks rise fully as high, but which are not so long, nor so prominent by virtue of their names. The highest of these hills have not been measured, but certainly some of them surpass 700 feet, for two or three will almost equal Mud Lick mountain, which is 793 feet above the valley.

(Here follows a page more on topography.)

Many other instances might be given, particularly in the article on weathering of granite rocks, the fissures in the rocks, etc. Every instance mentioned on page 95, such as that of the St. Francois river, was taken direct from the manuscript without any intimation of its source. The figures illustrating Keyes' chapter were principally taken from photographs which constituted a part of my manuscript as it was sent to Jefferson City in August, 1893. Plates III., VI., VII. and XI. are reproduced photographs taken by myself and Winslow of places I specially chose. Plate IV. was taken by Mr. Ladd years ago at my request, while plate X. was called for by my manuscript, although I did not have a copy of the photograph to send with the manuscript.

In his letter of November 15, in referring to my intimation that he had plagiarized he said: "To say that it is, is most emphatically false, to the very last letter." The reader who has sufficient interest to compare the parallel columns above may judge for himself. No one doubts a State Geologist's privilege of writing as many 'introductions' as he may wish, but others also have the prerogative of questioning the utility of such 'introductions' when the State Geologist is compelled to go to a suppressed manuscript to find something to say.

Dr. Keyes seems to be an adept in borrowing illustrations without proper acknowledgment. In Volume I., Iowa Geological Survey, plate IX. was made from a photograph taken by Prof. C. H. Gordon. He subsequently published it in Volume II. as plate IV., and in his report on paleontology for Missouri in Volume IV., plate IX., all without any acknowledgments, although Prof. Gordon had called his attention to the matter (A. J. Sci. (3), Vol. XLVI., p. 398, 1893). In Vol. 2, Proceedings

Iowa Academy of Science, he published plates III. and IV., without acknowledgments, which were first published by Winslow in the text of the Iron Mountain sheet as plates III. and II. For his introduction to my report from the same place he borrowed plates I. and III., using them as plates II., VIII. and IX., respectively, again without acknowledgments. And yet on November 14 he wrote me: "I have only the simple statement to make that no one holds in higher reverence the giving of all due credit to whom it belongs and no one has tried harder than I to give it on all and every occasion."

ERASMUS HAWORTH.

SCIENTIFIC LITERATURE.

A Review of the Weasels of Eastern North America. By OUTRAM BANGS, Proc. Biol. Soc. of Washington, X., pp. 1–24, pls. I.–III., Feb. 25, 1896.

In clearing up the status of the Weasels of eastern North America, Mr. Bangs has done a piece of work that will be welcomed by all mammalogists. He has had access to practically all the material thus far accumulated by American naturalists on the species treated; his results leave little to be desired.

All three of the species named by Bonaparte in 1838—*richardsoni*, *cicognani* and *longicauda*—are found to be valid, and their geographic ranges are for the first time defined. The weasel which heretofore has been persistently confounded with the European *Putorius erminea* is found to be a very distinct species for which the name *P. noveboracensis* of Dekay and Emmons becomes available. This animal is the common large weasel of the Eastern States, where it ranges from the mountains of North Carolina northward to northern New York and central Maine. It is not known from any point west of Illinois.

The small weasel of the Northern States, which it has been customary to call *P. vulgaris*, is the *P. cicognani* of Bonaparte, as recognized by Baird and Mearns, but overlooked by most mammalogists. *P. cicognani* is a northern animal ranging from New York and New England northward, and extending westward all the way to Alaska. Mr. Bangs believes that it intergrades, in the far North, with the arctic *P. richardsoni*, the type of which came from Great Bear Lake. *P. richardsoni* ranges from Hudson Bay to the coast of Alaska.

The weasel of the northern plains, *P. longicauda* Bonaparte, becomes considerably darker along the edge of the forest belt in Minnesota, and the dark form is named as a subspecies, *spadix*.

But the most interesting novelty is a tiny species from the plains of the Saskatchewan, which Mr. Bangs names *P. rixosus*. It is not only the smallest of the weasels, but it is believed to be the smallest known Carnivorous mammal. It has a very short tail, which lacks the black tip of all other species, and in winter the little animal turns white all over. It ranges from Hudson Bay to the coast of Alaska and is exceedingly rare in collections.

The rarest weasel of all is the Florida species, *P. peninsulæ*, recently described by S. N. Rhoads. Only half a dozen specimens, mostly poor, have as yet found their way into collections.

Mr. Bangs' paper is an excellent example of the kind of work American mammalogists have been doing for the past few years. It is based on a sufficient number of specimens to admit of final conclusions, and the specimens have been studied so thoroughly that no other conclusions are likely to be suggested in future.

The paper is illustrated by 3 excellent plates of skulls, all drawn by Dr. James C. McConnell.

C. H. M.

Report on Field-work in Chenango County [New York]. By J. M. CLARKE. (In Thirteenth An. Rept. State Geologist [N. Y.] for the year 1893, Vol. I., Geology. Pp. 529–557, 1 plate, 10 figures.)

Volume I. of the last annual report of the State Geologist of New York forms a book of nearly 600 pages which is devoted to a description of the geology of certain portions of the state and is profusely illustrated with maps, sections, figures and plates. The greater number of separate papers composing the report are not only filled with interesting facts, but also increase our knowledge of the geology of the State to a considerable extent.

laid is moving the decimal point till it stands directly after the first significant figure. Thus $850.72 = 8.5072 \cdot 10^{2}$; $0.000652 = 6.52 \cdot 10^{-4}$.

We cannot go into details, but may say that Prof. Holman's rules are few and simple, and so abundantly illustrated that students will find little difficulty in applying them. The book is probably the best, in its particular field, which is available for American students and engineers. When five-place tables are not sufficiently accurate the author recommends the well-known Vega or other seven-place tables. It is a pity that engineers and others seem to be unaware that Bremiker's six-place tables, revised by Albrecht, are sufficiently accurate for almost any problem which occurs in practice, and are easier to use than any seven-place tables.

A few peculiarities of Prof. Holman's book deserve notice. Negative characteristics are used, even in the tables, and recommended. Decimal points are introduced in the arguments of the tables of logarithms of natural numbers; instead of 621, 6.21 is printed. Interpolation tables are not given for all the tabular differences on a given page, when the differences are large, even though there is ample room on the margin of the page. The interpolation tables given are not accurate. Thus $0.3 \cdot 22$ is called 7 instead of 6.6; this suffices in multiplying by one figure, but in division needless inaccuracy may arise.

In the table of 5-place logarithmic trigonometric functions the argument is for each minute, but no proportional parts are given. There is no provision for finding accurately the logarithmic sines and tangents of small angles involving fractional parts of a minute.

A student will sometimes wish that the author had been a little more particular in his statements. On page xii., for example, after stating two fundamental propositions, "which one can easily verify by algebra or by numerical examples," the author adds:

"A more general form of statement from which these follow is: If several numbers are multiplied or divided, a given percentage error in any one of them will produce the same percentage error in the result." Take the example $\frac{120}{2} = 60$. The student will think that the author means that if the divisor 2 be in error by 25% of itself, the quotient is in error by 25% of itself. This he will find to be false. Had the author given a definition of 'percentage error,' the student would be able to determine whether the above statement were exact, or simply approximately true for such examples as are likely to occur in practice. The two propositions mentioned above might be improved by re-writing.

Two errata have been noticed: In the first line of p. xxiii for 'numerator' read 'denominator;' in the last line of p. xii for 'merely' read 'nearly.'

The book is elegantly printed on heavy paper; one can only wish that it were so bound that it would lie open with a flat page, a *sine qua non* of logarithmetic tables.

HERBERT A. HOWE.
UNIVERSITY OF DENVER.

SCIENTIFIC JOURNALS.

AMERICAN JOURNAL OF SCIENCE.

THE subject of the Röntgen rays is discussed in the *March number* by A. A. Michelson, who proposes a new hypothesis to account for the phenomena observed. He mentions, first, the two theories that have hitherto been suggested, that of longitudinal waves and that of projected particles, and remarks upon the special difficulties which each of these theories meets. His own hypothesis he calls the 'Ether-Vortex' theory, which he states as follows:

"Let it be supposed that the X-rays are vortices of an intermolecular medium (provisionally, the ether). These vortices are produced at the surface of the cathode by the negative charge, which forces them out from among the molecules of the cathode." He shows that certain of the phenomena which are most typical and difficult to explain may be accounted for on this supposition. The fact that a high vacuum is essential within the tube while, once outside, the rays can pass not only through air, but also through many solids, is regarded as finding a solution if it be considered that, in order that ether vortices may result from the electrical impulse, this impulse must be communicated to them, and must not be dissipated in the interchange of molecular charges which

On many accounts the report of Dr. Clarke describing the geologic structure of a portion of Chenango county is one of the most important of these contributions, since it considers the correlation of the rocks for a part of the State concerning which great uncertainty and difference of opinion have prevailed. The plate at the beginning of the article gives a clear idea of the character of the sandstones and shales at the base of Vanuxem's Oneonta sandstone, while the figures bring out nicely the lithologic and stratigraphic features of the various sections, which are carefully described by the author and are accompanied by accurate lists of the species of fossils found in the various beds. In the lower exposures, near Norwich, Dr. Clarke found abundant Hamilton fossils; above these Hamilton species also, but with them specimens of *Spirifer mesastrialis*, *Actinopteria zeta* and a few other species which occur in the 'Ithaca group,' while in the upper part of the shales and sandstones, below the Oneonta sandstone, fossils are very scarce.

The formations of the Middle and Upper Hamilton of central and western New York are usually given in ascending order as the Marcellus shale, Hamilton sandstone with the Tully limestone at the top, Genesee shale, Portage formation (which in central and eastern New York is partly replaced by the 'Ithaca group' and Oneonta sandstone), and Chemung formation. These formations form the Hamilton and Chemung series, the line of separation usually being drawn at the top of the Genesee, although some authors prefer to place it at the base of the Tully limestone.

The Genesee shales and Tully limestone form a marked horizon across western New York, but they disappear in going eastward and are not clearly known east of the Chenango valley. In this eastern area Hamilton fossils, with the addition of a few species found in the 'Ithaca group,' occur in the bluish shales and sandstones underlying the Oneonta sandstones, and whether these deposits belong in the Hamilton formation, or are above the horizon of the Genesee shale and Tully limestone, has been a greatly disputed question.

Dr. Clarke found in the western part of Chenango county that the Hamilton fauna with *Spirifer mesastrialis*, 'and of quite the same character as that of the lower beds at Norwich,' is clearly and unmistakably above the Genesee shales. Consequently it will be readily seen that this work is of great value in accurately determining the line of separation between the Hamilton and Chemung series in central New York. In passing it may be stated that this conclusion agrees with the writer's interpretation of the section near Smyrna, twelve miles north of Norwich, which is at the most eastern unquestioned exposure of Tully and Genesee.

The final settlement of difficult questions of this nature in correlation—and there are many in the United States—will be obtained by careful field study of a typical region by a geologist familiar with its paleontology and also versed in stratigraphical geology.

A preliminary copy of the Geologic Map of New York is now passing through the press, and the above and later work of Dr. Clarke, as well as that of other assistants, will be of great value in revising this map upon which the veteran State Geologist, Prof. James Hall, has been actively engaged for so many years.

C. S. Prosser.

Computation Rules and Logarithms. S. W. Holman. Macmillan & Co., New York. $1.00.

Prof. Holman's book is the outgrowth of several years' experience with large classes and is sufficient for most of the computations occurring in engineering, physics and chemistry. The tabular matter consists of a variety of five and four-place tables, together with modern values of important constants. The introduction, which comprises one-third of the book, is of great value, its chief object being to teach students how to get results of any desired degree of accuracy without wasting time and labor in the manipulation of useless figures. For instance, the H. P. which can be transmitted safely by a certain wrought-iron shaft is $2\pi^2 \cdot 1.364^3 \cdot 10000 \cdot 300/6336000$. How many places of logarithms are to be employed, if the computation-error is not to exceed one per cent.? By one of the author's rules it is instantly decided that four-place logarithms will give ample accuracy. One of the devices on which stress is

3. In sulphur chloride the sulphur is apparently dissociated to the same extent as in the vapor at high temperatures, the molecular complexity being represented by S_2.

On the Determination of Sulphur in Illuminating Gas and in Coal. By CHARLES F. MABERY.

The author uses a modification of Sauer's method, burning the gas in a tube in a stream of air, the products formed being absorbed in a standard alkaline solution. The coal is burned in the same way, being introduced into the tube in a platinum boat. The amount of sulphur left in the ash is less than 0.05 per cent. on an average.

Chemistry of the Berea Grit Petroleum. By CHARLES F. MABERY and O. C. DUNN.

A brief account is given of the most important wells and their output, and the character and properties of the petroleum from the Berea Grit.

A Method for the Standardization of Potassium Permanganate and Sulphuric acid. By H. N. MORSE and A. D. CHAMBERS.

If a known quantity of standard sulphuric acid is treated with hydrogen peroxide and potassium permanganate added as long as the color disappears, and more hydrogen peroxide and permanganate added until most of the acid has been used up, and the excess determined by titration with the standard ammonia solution, the strength of the permanganate can be easily calculated.

Some derivatives of unsymmetrical Tribrombenzol. By C. LORING JACKSON and F. B. GALLIVAN.

The authors find that two of the bromine atoms in tribromdinitrobenzol are easily replaced by treating with aniline or sodic ethylate. A number of derivatives are described.

Besides a review of recent work on Helium, and notes on the composition of Barium Picrate, and the proposed changes in the *Berichte* and '*Beilstein*,' this number contains reviews of the following books:

'Kurzes Handbuch der Kohlenhydrate,' Dr. B. Tollens; 'Die Chemie der Zuckerarten,' Dr. E. O. von Lippmann; 'Ostwald's Klassiker, Zur Entdeckung des Elektromagnetismus,' and 'Die Anfänge des natürlichen Systemes der chemischen Elemente;' 'Die Lehre von der Elektrizität,' G. Wiedemann; 'Physikalisch-chemische Propædeutik,' H. Griesbach; 'A Laboratory Manual of Organic Chemistry,' Dr. Lassar-Cohn; 'Jahrbuch der Elektrochemie;' 'Anleitung zur Molekular-gewichtsbestimmung nach der *Beckmannschen* Gefrier- und Siedepunkts-Methode,' Dr. G. Fuchs; 'Einführung in die mathematische Behandlung der Naturwissenschaften,' W. Nernst; 'Elements of Modern Chemistry,' C. A. Wurtz.

J. ELLIOTT GILPIN.

PSYCHE, APRIL.

S. H. SCUDDER gives a table to separate the 13 New England species of Melanopli, 10 of them belonging to the genus Melanoplus; H. F. Wickham continues former studies on myrmecophilous Coleoptera; and a notice is added of Plateau's recent experiments on insect vision. A Supplement contains the conclusion of C. F. Baker's account of some new New Mexican Homoptera and the beginning of descriptions of new species of bees of the genus Prosopis (or Prosapis, as the author prefers), by T. D. A. Cockerell.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES.

AT the meeting of the Biological Section, on March 9th, 1896, Mr. F. B. Sumner read a paper on 'The Descent Tree of the Variations of a Land Snail from the Philippines,' illustrated by a lantern slide. Mr. Sumner described the range in variation in size and markings in the shell, and arranged the varieties in the form of a tree of three branches diverging from the most genealized type. It was shown that these several varieties occupy the same geographical region, and Mr. Sumner was of the opinion that their occurrence could not be explained by natural selection since if the colorations were supposed to be protective it would be impossible to explain the evolution of these three types. Prof. Osborn, in discussion, was inclined to take the same view. Dr. Dyar, however, thought the explanation by natural selection not necessarily excluded, since the variations seemed analogous to the dimorphism in sphinx larvæ, which has been shown by Poulton to be probably due to this factor.

accompanies, or rather produces, the discharge at moderate or high pressures. At the high exhaustion the energy of the discharge would be largely confined to the ether vortices. The absence of the ordinary light phenomena of reflection, etc., would follow from the nature of vortices.

The first article of the number is by C. E. Beecher, on the 'Morphology of Triarthrus.' This is a continuation and an extension of earlier articles by the same author upon the structure of Trilobites. The results given are presented on a plate showing the dorsal and ventral views of the species, *Triarthrus Becki*. These have been made from drawings based, the first upon three specimens, and the second upon two, all in a very exceptional state of preservation. The perfection with which the appendages of the trilobite are preserved and the life-like position in which they are shown is most remarkable. The author is enabled to draw from them definite conclusions in regard to the relations and functions of these organs of which so little has been known hitherto.

A. E. Ortmann discusses the subject of the existence of climatic zones in Jurassic times, with special reference to the arguments for them given by Neumayr. He contends strongly against Neumayr's views and states his conclusion finally that the differences observed in the faunas of the Jurassic deposits are not caused by climatic differences. J. E. Wolff describes an occurrence of the rare rock, theralite, from Costa Rica, from specimens collected by Prof. R. T. Hill. The rock bears a close similarity to the original type from Montana. The possible existence of a zone of alkaline rocks continuing from the northwestern United States on the east border of the Rocky Mountains is suggested. C. H. Smyth, Jr., describes in detail an occurrence of gabbro and associated gneiss near Russell, St. Lawrence county, N. Y. The gneiss is regarded as derived by the metamorphism of the gabbro resulting finally in entire re-crystallization and the removal of all cataclastic structure. Another extended petrological paper is by W. H. Weed and L. V. Pirsson, forming the first part of a memoir upon the Bearpaw Mountains, in Montana. This is a region which has been hitherto but little investigated geologically. After a brief statement of the general geology, the relation of the sedimentary rocks, largely Cretaceous, to the massive, igneous rocks and tuffs, the authors go on to describe more particularly the igneous rocks, including both the effusive and intrusive forms. The former are most abundant, forming the highest peaks and many of the lesser summits of the region; they are the usual rocks of the foot hills, embracing dark-colored basaltic tuffs, breccias and lava flows, which are parts of the former volcanic cones. They consist largely of lencite basalts. The intrusive rocks described include various forms of trachyte and quartz-syenite porphyry; also associated with the syenite, the rock shonkinite, a type described by the same authors from Yogo Peak, Montana. H. B. Bashore gives some notes on glacial gravel in the lower Susquehanna. Robert Chalmers describes the Pleistocene marine shorelines on the south side of the St. Lawrence Valley, connecting them with the terraces noted farther west along Lake Ontario. The occurrence of free gold scattered in scales through the quartz and feldspar of a granite-like rock from Sonora, Mexico, is described by G. P. Merrill. He shows that the gold cannot be regarded as of secondary origin, assuming that the rock is a normal granite, the occurrence is novel and of decided importance. The number concludes with a series of abstracts, book notices, etc.

AMERICAN CHEMICAL JOURNAL, MARCH.

The Molecular Weight of Sulphur. By W. R. Orndorff and G. L. Terrasse.

In the course of an investigation on the molecular weight of monoclinic sulphur some remarkable results were obtained. Although both the boiling-point and freezing-point methods were used, the results from the latter were not concordant and no conclusions can be drawn from them. The results obtained by the other method are as follows:

1. The molecular weight of sulphur in liquids whose boiling-points are below the melting-point of sulphur, as for example, benzene and toluene, is represented by S_9.

2. In liquids boiling above the melting point of sulphur, the molecular formula is S_8.

The other paper was by Dr. Arnold Graf on 'The Problem of the Transmission of Acquired Characters.'

Dr. Graf discussed the views of the modern schools of evolutionists and adopted the view that the transmission of acquired characters must be admitted to occur. He cited several examples which seemed to support this view, and especially discussed the sucker in leeches as an adaptation to parasitism and the evolution of the chambered shell in a series of fossil Cephalopods.

Professor Osborn remarked in criticism of Dr. Graaf's paper that this statement does not appear to recognize the distinction between *ontogenic* and *phylogenic* variation, or that the adult form of any organism is an exponent of the stirp, or constitution. If the environment is normal the adult would be normal, but if the environment (which includes all the atmospheric, chemical, nutritive, motor and psychical circumstances under which the animal is reared) were to change, the adult would change correspondingly; and these changes would be so profound that in many cases it would appear as if the constitution or stirp had also changed. Illustrations might be given of changes of the most profound character induced by changes in either of the above factors of the environment, and in the case of the motor factor or animal motion the habits of the animal might, in the course of a life time, profoundly modify its structure. For example, if the human infant were brought up in the branches of a tree as an arboreal type instead of as a terrestrial, bi-pedal type, there is little doubt that some of the well-known early adaptations to arboreal habit (such as the turning in of the soles of feet and the grasping of the hands) might be retained and cultivated, thus a profoundly different type of man would be produced. Similar changes in the action of environment are constantly in progress in nature, since there is no doubt that the changes of environment and the new habits which it so brings about far outstrip all changes in constitution. This fact, which has not been sufficiently emphasized before, offers an explanation of the evidence advanced by Cope and other writers that change in the forms of the skeletons of the vertebrates first appears in ontogeny and subsequently in phylogeny. During the enormously long period of time in which habits induced ontogenic variations it is possible for natural selection to work very slowly and gradually upon predispositions to useful correlated variations, and thus what are primarily *ontogenic variations* become slowly apparent as *phylogenic variations* or congenital characters of the race. Man, for instance, has been upon the earth perhaps seventy thousand years; natural selection has been slowly operating upon certain of these predispositions, but has not yet eliminated those traces of the human arboreal habits, nor completely adapted the human frame to the upright position. This is as much an expression of habit and ontogenic variation as it is a constitutional character. Very similar views were expressed to the speaker in a conversation recently held with Prof. Lloyd Morgan, and it appears as if a similar conclusion had been arrived at independently. Prof. Morgan believed that this explanation could be applied to all cases of adaptive modification, but it is evident that this cannot be so, because the teeth here undergo the same progressively adaptive evolution along determinate lines as the skeleton, and yet it is well known that they do not improve by use, but rather deteriorate. Thus the explanation is not one which satisfies all cases, but it does seem to meet, and to a certain extent undermine, the special cases of evidence of the inheritance of acquired characters, collected by Prof. Cope in his well-known papers upon this subject.

C. L. Bristol,
Secretary.

NEW YORK ACADEMY OF SCIENCES.

At the meeting of the Section of Geology and Mineralogy of the New York Academy of Sciences, held March 16th, Prof. J. J. Stevenson in the chair, the first paper of the evening was presented by Mr. Heinrich Ries on 'A Visit to the Bauxite Mines of Georgia and Alabama.' The speaker first outlined the occurrence of bauxite in Europe and in the United States, illustrating his remarks by means of lantern slides. He then described his trip through the bauxite region of the States mentioned, using the same method of illustration and exhibiting

a large series of specimens. Mr. Ries showed the association of bauxite with occasional beds of limonite and lignite and the frequent occurrence of white clays in connection with the ore. In their geological relations nothing of moment was, however, brought to light that has not already been published by Dr. C. W. Hayes in his recent paper in the 16th Annual Report of the Director of the U. S. Geological Survey. In the discussion Mr. R. E. Dodge called attention to the close connection between the bauxite and the tertiary peneplain of the region, so that the ores are not found, except at a point where the great fault lines of the region cut the Knox dolomite between 900 and 950 feet above tide, as shown by Dr. Hayes. Prof. Kemp in discussion called attention to the close association of limonite and lignite with the bauxite, and remarked the close parallel that exists between these deposits and the siluro-cambrian iron ores of the North. In the South we have hydrated oxide of aluminum, with subordinate limonite. In the North the iron oxide is in excess, while the hydrated oxide of aluminum is present only in the somewhat uncommon mineral gibbsite. He also remarked the existence of lignites at Brandon, Vt., and Mont Alto, Pa. While the limonites of the North have been in part derived from the sulphate of iron produced by decomposing pyrites, but little hydrate of alumina seems to have been formed by the sulphuric acid which has also of necessity resulted. Prof. Kemp further remarked that a recent article in the *Engineering and Mining Journal* of March 14th stated that the gossan of the Royal gold mine, near Tallapoosa, Ga., extended a considerable distance below the present water, line and he suggested that it perhaps indicated a recent depression which has brought the oxidized zone below the ground water.

The second paper of the evening was by Mr. R. E. Dodge on 'The Cretaceous and Tertiary Peneplains of Eastern Tennessee,' on the basis of observations accumulated during two summers' field work in the region under Mr. C. W. Hayes, of the United States Geological Survey. The speaker described the geographical development since the cretaceous period of the country lying west from Chattanooga and across the Sequatchie Valley to the Mississippi River. By means of maps and sections Mr. Dodge first set forth the geology of the old cretaceous peneplain now forming the Cumberland Plateau with a few monadnocks projecting above it; next the tertiary peneplain that shows like a great shelf on each side of the river valley; and then the present river valleys and the plains to the west of the plateau region which are now being still further notched by the active streams. A map of the region that the speaker had prepared and colored so as to show the extent of each peneplain, or, in other words, the geographic development, was exhibited and commented upon. In discussion Prof. Stevenson remarked the high terraces that he had met along the Monongahela, Allegheny, Cheat and New Rivers in Pennsylvania and West Virginia. He referred to their uniform attitudes over wide areas and to their occurrences above the river terraces. He seemed to favor, however, the view that they were wave-cut terraces remaining from a period of submergence, but remarked that they were wonderfully well preserved for ones of ancient date, and that they exhibit an extraordinary lack of superficial pebbles such as should accompany a wave-cut terrace.

The section then elected for the ensuing year the same officers that had held office last year, viz: J. J. Stevenson, Chairman, and J. F. Kemp, Secretary.

J. F. KEMP,
Secretary.

ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

THE 246th regular meeting of the Anthropological Society was held Tuesday, March 3, 1896. Surgeon General George M. Sternberg read a paper on 'Vivisection: Its Objects and Results.'

In the course of his paper Dr. Sternberg said that by dissection of dead plants and animals only can we determine the nature of their functions. The study of the results of disease processes in the post-mortem room cannot settle questions, he said, relating to the etiology of disease, its mode of transmission, if infectious, its clinical history or its treatment. These are questions which concern patient and physician, and scientific medicine depends upon their so-

lution by scientific methods, that is, by experiment.

Progress in the biological sciences calls for experiments on living things. The term vivisection originally related only to cutting operations upon living animals. Its use has been extended by those who have been led to enter upon a crusade against experiments on living animals, so that now it includes all experiments to which they are subjected.

Thus, said the speaker, the injection of bacteria under the skin of a guinea pig becomes vivisection. It is by experiments of this kind that our knowledge of disease germs has been acquired, and without such experiments it would be absolutely impossible to distinguish the harmless bacteria and the deadly germs of tuberculosis, cholera, typhoid fever, puerperal fever, anthrax and the like, which are now well-known in pathological laboratories.

Such experiments have resulted in an immense saving of human life, yet the anti-vivisectionists insist that they are unjustifiable, and would enact measures calculated to entirely arrest all profitable research in this most important department of human knowledge.

Continuing, General Sternberg said that when the dissection of dead plants and animals was first practiced there was great opposition to it on the part of those who did not realize what could be accomplished thereby. One great fault that has seriously retarded the progress of medicine is that there has been altogether too much deduction from insufficient data. This is proved in part in other departments of life by a curious feature of the times, the revival of interest in palmistry, faith cure and matters of that sort, and the absolute reliance which a great many people place in the virtues of patent medicines as panaceas for all ills. If one controverts the views of a believer in any of these he will be met by the recital of some particular incident, unsupported, which answers the purpose of absolute proof to the credulous. This sort of credence is not altogether lacking in the medical profession. Final conclusions cannot always be reached by chemical methods, but much must be done by hospital experiments. These often furnish extremely valuable additions to our scientific knowledge, but it is not always possible to carry these experiments sufficiently far. Fuller and more valuable results may often be obtained by experiments on the lower animals in the hands of a master.

He quoted, in support of his position, the story of one of Pasteur's experiments by means of which, sacrificing the lives of a few animals, he discovered the bacillus of anthrax, and thereby saved the lives of millions of animals. The fact that anthrax inoculation is now so generally practiced was due to Pasteur's work, which could never have been carried through without vivisection. Formerly ten per cent. of all the sheep and five per cent. of all the cattle in France died from this disease, and his study of the malady has resulted in a saving, in France alone, of 5,000,000 francs a year for sheep and 2,000,000 francs' worth of cattle. He also spoke of Pasteur's experiments on the subject of hydrophobia, pointing out the tremendous blessings which have accrued to the human race from the work of the famous French scientist, a work, however, which necessitated the sacrifice of a few animals. As a result of his experiments and study, mortality from hydrophobia among human beings has been reduced to less than one per cent. In a record of 416 cases of people who had been bitten by animals known beyond question to have been mad, treated by the Pasteur method, not one died.

Vivisection has resulted in a great increase in the exactness of medicine and surgery, and any further progress in biology calls for experiments upon living things. In the consideration of vivisection is placed on the one side the tremendous advance in science, the increased immunity from disease and the great saving to the material wealth of the world, while on the other side of the balance is the thought of the animals, comparatively few in number, which have been sacrified. As human lives are too sacred to risk in solving the questions of pathogenic potency, we resort to lower animals, and vivisection has resulted in a great saving of human life. The painful dissections made by the early investigators, and necessary in the beginning, are rarely, if ever, made nowadays. The statements presented by the ultra anti-vivisectionists that unnecessary cruelty is used

and that many experimenters seem to take an actual delight in the sufferings of their victims, Gen. Sternberg characterized as a gross and unfounded calumny. Vivisection is practiced by members of the humane profession of science in the interest of humanity. Those who deny that any valuable results have ever accrued from vivisection simply show how ignorant they are, and only prove themselves fit subjects for a course of elementary lectures.

The discovery of anti-toxin is one of the blessings that has resulted from experiments upon the lower animals. Scientists would have to stop just where they are to-day if they were prevented now altogether from the practice of vivisection. In securing the anti-toxin, very little suffering is inflicted upon the horse, from which it is obtained, but it must then be tested upon guinea pigs to determine its character and potency. If we object to using guinea pigs for this purpose, then we are compelled to act blindly and must take our chances with the children.

In conclusion, Dr. Sternberg characterized as well meaning, but ill advised, the efforts of those people who seek, by organization, agitation, and in every other way to hinder or absolutely put a stop to a practice which is recognized as necessary to any further advance in scientific medicine.

Dr. Baker considered the question from the physiological point of view. He reviewed the history of the study of the human body from the earliest days down, showing the crude ideas which were entertained on the subject by Hippocrates and other physicians of long ago. He traced the development down to the present time, recounting the experiments which were necessary, and which were made from time to time, without which we would know no more of the functions of the human body than did Galen. Harvey was an enthusiastic vivisectionist, and if he had not been, he could never have discovered the circulation of the blood. That he did discover it resulted from the fact that he cut into the thorax and saw the blood coursing through the arteries and the heart beating. To ask scientists to study anatomy without seeing what is actually within the body would be precisely the same as to ask a man to study the mechanism of a mill by standing outside and listening to the noise of the spindles.

Dr. Salmon, Chief of Bureau of Animal Industry spoke of the role vivisection had played in the discoveries of, 1, Anthrax by Koch, 2, Chicken Cholera bacillus of Pasteur, 3, Immunity as first advocated by the Bureau of Animal Industry and 4, the discoveries and researches in Antitoxin based upon this doctrine. He also cited the million of lives and money saved by the investigations in pleuro-pneumonia, hog cholera, Texas fever and tuberculosis, which had become of international interest, due to the exclusion of our cattle from France to Germany.

Mr. Kennedy, of the Anti-vivisection Society, defined the term 'vivisection' so as not to include inoculation, and claimed that their purpose was to have governmental supervision over experiments, and based his arguments solely on sentimental grounds, claiming that since many experiments had failed therefore it was cruelty to animals destroyed in these unsuccessful attempts.

Dr. Ch. Wardell Stiles spoke of the utility and results of animal experimentation in comparative invertebrate zoölogy as applied to human and comparative medicine. He made the general statements. (1.) That all animals are infested with animal parasites. (2.) That some parasitic diseases may be treated successfully while others cannot; in this later case we must deal with *prevention* rather than *cure*. (3.) A study of the embryological phases of the parasites is necessary before we can establish satisfactory prophylactic measures. (4.) The data regarding the embryology including life-history can be obtained only through animal experimentation.

The speaker next cited some of the better known parasitic diseases of man and the domesticated animals and showed the various steps by which the zoölogist had placed the medical profession in a position to meet these maladies. *Trichine spiralic* (*Trichina spiralis*) was first described in 1835 as a harmless parasite; its life-history was discovered in 1850 but not until 1860 was it shown to be the cause of a well defined disease which up to that time had been confounded with typhoid fever. Its life-

history as well as the various prophylactic measures were discovered by experimentation and could have been obtained in no other way. The same is true regarding tape worms and flukes. Through a study of the embryology of these parasites by means of animal experimentation data have been obtained for the proper methods of prevention.

The study of animal parasites bears a close relation in differential diagnosis to the bacterial diseases, for verminous nodular diseases are found in cattle, sheep, chickens, etc., which resemble tuberculosis and are often mistaken for it.

Regarding anæsthetics Dr. Stiles said that they could not be used in his line of work as it was necessary to keep the animals under experimentation for several days, weeks or even months at a time. He was firmly of the opinion, however, that the inconvenience suffered by the animals in experiment was, in the vast majority of cases more of the nature of weakness than of actual physical pain. He claimed that the appetite of the animals was an excellent index to the amount of pain they suffered since an animal in severe pain refuses food. In experiments with animal parasites the hosts nearly always retained their appetites and the speaker maintained that even in the severe experiments the pain suffered by the animals was almost insignificant when compared with the pain a human being would suffer in the same stages of the same diseases.

J. H. McCormick,
General Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

At the 45th meeting of this Society, held in Washington, D. C., March 11th, President S. F. Emmons in the chair, two papers were read, one by Bailey Willis on 'Evidences of Ancient Shores, and the other by David White on 'The Thickness and Equivalence of Some Basal Coal Measure Sections along the Eastern Margin of the Appalachian Basin.'

Mr. Willis discussed the evidences of ancient shores with reference to their position, trend and duration. Five classes of evidence were enumerated: namely, (1) overlap or unconformity; (2) suncracks, trails or ripple marks; (3) coarser deposits; (4) thicker deposits, and (5) synclines of deposition.

Any point of an unconformity marks with precision a point on some shore line at some instant of time, but as the outcrop of an unconformity cannot be assumed to be parallel to the former shore line, this evidence does not define the trend of the ancient shore, and as the shore was in transit its duration was transient.

In contrast with this conclusion was placed that derived from thick deposits of shales such as are formed by the delivery of a large volume of sediment concentrated at the mouth of a river draining an extensive watershed. These conditions result in the accumulation of a lenticular formation which thickens rapidly from the shore to a maximum and thins more gradually seaward. When the thickness of the shale is pronounced, the duration of the conditions was probably long continued. Such evidence, therefore, indicates the approximate position, general trend and long duration of the ancient shore.

In folded regions such conditions of deposition as have just been described have determined the positions of synclines of the greatest magnitude, the synclines of deposition. Such folds are further characterized by a very steep dip on the shoreward side and by the stratigraphy, which should include a massive bed of shale. When sufficiently characteristic to be recognized, the syncline of deposition thus becomes an evidence of proximation to shore, with axis parallel to its general trend; the infolded strata may also indicate the prolonged duration of the neighboring shoreline.

Thus the causal relation which exists between sedimentation and folding is appealed to, to aid in the determination of ancient shorelines.

Mr. David White communicated informally some preliminary results of his recent work under instructions from the Director of the Geological Survey in the stratigraphic paleontology of the lower portion of the Carboniferous proper (Mesocarboniferous) and of the Pottsville series in particular. The speaker exhibited columnar sections of the series near Coxton, Pottsville and Tremont, Pa.; Piedmont, the New River and the Tug River, W. Va.; Soddy, Tenn., and in the Warrior Coalfield, Ala., on which were

indicated the stratigraphic position and vertical extent of the paleontologic divisions of the Pottsville series.

Although the plant collections are often fragmentary or represent only one or more levels in some of the sections, the individual collections are generally clearly referable to one of the floral divisions, suggested in the author's preliminary paper on the New River section at the Baltimore meeting of the Geological Society of America, viz: Pocahontas, Horsepen and Sewanee, in ascending order, while the approximate level in that division is also frequently indicated with considerable reliability, as is shown by stratigraphic verification. The limits of these floral divisions, now fairly well determined in the New River section, have been traced through the Flat Top-Tug River section, where the total thickness is seen to expand far beyond the 1,700 feet of the New River section, while material from two localities in the Big Stone Gap, Va., region shows the presence of a flora belonging to the Sewanee division, at a probable height of 2,300 feet above the base of the series, denoting, perhaps, the maximum thickness of the series near this point in the central Appalachian trough.

Special importance attaches to the author's conclusions that the inclusion of the lower part of the 'Walden sandstone' of Hayes, represented by the 'Second Series' of Safford, in the upper or Sewanee division of the Pottsville series is fully demonstrated by the fossils of the West Virginia and the type (Pottsville) sections, while the underlying terranes, including the 'Millstone Grit' and upper part, at least, of the 'Sub-conglomerate' of Safford or the 'Lookout Sandstone' of Hayes are referable to the Horsepen division. Such scanty fossil material from Alabama as is available indicates that in the Warrior coalfield the Warrior and Black Creek seams belong in the Horsepen division, while the Newcastle and Pratt seams appear to fall within, certainly not above, the Sewanee division, though the Pratt seam is said to be about 1800 feet above the base of the series. Such a correlation necessitates placing the boundary of the Lower Productive Coal Measures many hundreds of feet higher in Tennessee and Alabama than has yet been done by the geologists in those States. It also follows that the Lykens Valley coals in Pennsylvania, the New River and Pocahontas coals of West Virginia, as well as the valuable coking coals of Tennessee and Alabama, all seem to fall within the limits of the Pottsville series.

Attention was also called to the absence of the Pocahontas and even the Horsepen division floras in some of the thin sections of the series in this basin, apparently disproving the generally accepted view that the difference between the thick and the thin sections is wholly a question of expansion.

Mr. M. R. Campbell described briefly the result of his recent stratigraphic work in the coalfield of Virginia and West Virginia. From New River to Big Stone Gap his correlations, based entirely upon stratigraphic work, agree essentially with Mr. White's correlations, showing that the two methods are harmonious and lead to the same results.

W. F. MORSELL.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, MARCH 13, 1896.

ANTHROPOLOGICAL Section; Charles Morris, Recorder. Prof. T. Edge Kavanagh, of Ursinus College, spoke upon the subject of 'Right-Handedness.' It had been claimed that early man was ambidextrous, drawing of faces facing both ways being adduced in evidence of the fact; but on careful investigation this position had not been sustained. In primitive languages words associated or compounded with the word meaning left hand are symbolic of degeneration. Other data were given to sustain the view that primitive man was right-handed.

Bilateral asymmetry of the human body was not confined to the hand, but is the rule for the entire organism. The right eye was a little larger than the left, the right leg a little longer, the right tibia more calcareous, the right teeth stronger, hair and beard stronger on the right side, while sick headache attacked the left side, as did congenital and defective diseases. The evidence to be adduced from the movements of animals is too scant to be of much weight. The researches of Gratiotet and Brown-Sequard on the development of the human embryo were referred to. It had been suggested that the mat-

ter could be explained by the mechanical laws of the body: when the center of gravity is above the transverse median line, the person is right-handed; when median, ambidextrous; when below, left-handed.

Right-handedness he regarded as physiological and not the result of the evolution of a dextral habit. The left side of the brain controls the right side of the body and *vice versa*. The speech center is nearly always on the right side of the brain, the left speech center remaining undeveloped. He regarded right-handedness as a natural physiological development, and he therefore did not regard it as beneficial to cultivate ambidexterity.

Dr. Charles K. Mills thought it probable that in recovery from aphasia the loss of power in the speech center of the brain is not regained by a compensatory action of the other side, but through healing of the lesion in the diseased side. In children aphasia seems to occur equally from paralysis of both sides of the body; in adults from paralysis on one side alone. In aphasia from right-handed paralysis it is very difficult to teach writing with the left hand.

Dr. D. G. Brinton remarked that right- and left-handedness are not found in the anthropoid apes, and there is good reason to believe, from the formation of stone implements and modes of drawing of primitive man, that he was ambidextrous.

Prof. Jastrow stated that the farther back we go the less important the direction of writing becomes. In many ancient methods the writing might be done to right or left, according to the will of the writer. The same is the case with Chinese and Japanese writing. The earliest Greek inscriptions are written from right to left, the direction being changed at a later date.

Mr. H. C. Mercer did not think that the asymmetry of stone implements had any special significance. In stone chipping by modern Indians the grain of the stone largely governed the direction in which it is worked.

Prof. Heilprin called attention to the fact that Darwin had commented on the right-sidedness of a large proportion of animals.

Edw. J. Nolan,
Recording Secretary.

Boston Society of Natural History.

A general meeting was held March 4th, thirteen persons present. Prof. F. W. Putman, in his remarks upon Symbolism in Ancient America, insisted upon the importance of studying Ceramic art from its earlist beginning. The form, color, and style of ornamentation of ancient vessels and utensils was deseribed, and the resemblances between the decorative and symbolic carvings throughout the world noted. Implements made of native copper with the simplest tools were mentioned; also ear and head ornaments made of copper. Carvings upon the round surfaces of human bones clearly indicate design. The designs, methods of carving, and the various meanings of the carvings were explained.

A series of detailed drawings by Mr. Willoughby were also explained. The symbolic tablets of the Pueblo peoples and of the Mound Builders show but slight differences.

The peculiar character of the pottery of the Florida sand mounds was noted. The age of the mounds is uncertain; they are probably more than 800 or 1,000 years.

Samuel Henshaw,
Secretary.

The Academy of Science of St. Louis.

At the meeting of March 16th Mr. Trelease presented some of the results of a recent study of the poplars of North America, made by him for the Systematic Botany of North America, and exhibited specimens of the several species and recognized varieties. Specimens were also exhibited of an apparently undescribed poplar from the mountains of northern Mexico, which he proposed to characterize shortly, and, for comparison, specimens of the two other species of poplar known to occur in Mexico, and of the European allies of the supposed new species, were laid before the Academy. The paper was discussed by Drs. Green, Glatfelter and Kinner, Mr. Winslow and Professor Kinealy.

The Academy adopted resolutions favoring the appointment of a permanent chief for the scientific work of the United States Department of Agriculture.

William Trelease,
Recording Secretary.

Erratum: In Prof. Mills' article, page 442, paragraph 3, line 6, for 'smell,' read 'suck.'